ARTERIAL SCLEROSIS

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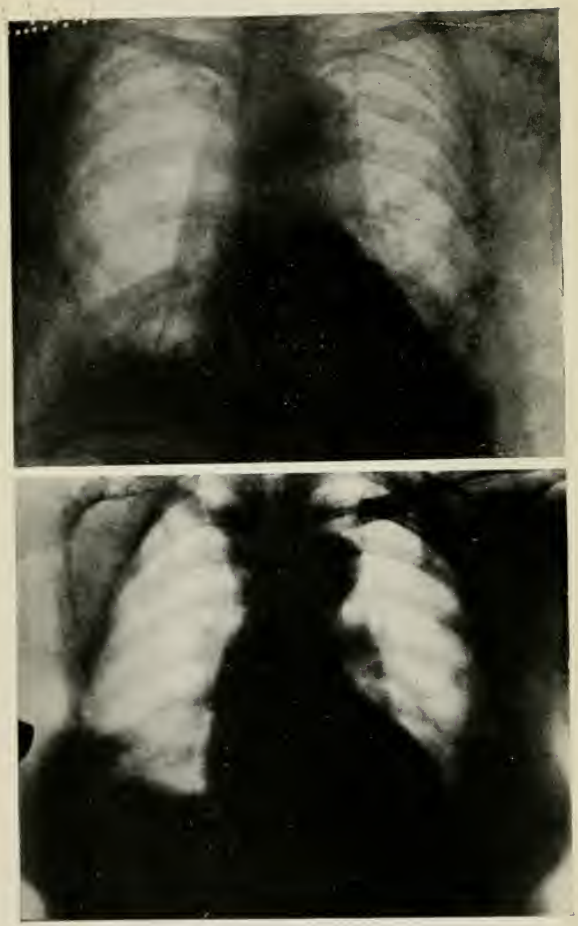

Frontispiece.

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ARTERIAL SCLEROSIS

A CONSIDERATION OF THE PROLONGATION OF LIFE AND EFFICIENCY AFTER FORTY

BY

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PREFACE

Arteriosclerosis is much more frequent than formerly. The causes for this are very many, and will be analysed in the body of the book, but it is well to warn ourselves in the beginning that two factors at least are nearly always necessary in the production of disease, and not fix on a single cause.

There must be an underlying tendency that has prepared the soil and collected the seed, and there must be the immediate occasion that plants the seed and favours its germination. In elaborating the theory of chemical intermediate causes that prepare the soil and provide the seed, we must not be thought to minimize the importance of nervous strain, dissipation and acute disease as breaking down the physiological defences and rendering the organism sensitive to particular molecules.

The modern age has lost much of the mental rest that came to previous generations through a respect for authority and a conviction that, whether contented or not, the average person was destined to remain in that condition of life in which he found himself. Undue ambition coming from the great opportunities of the time, together with a sensitiveness to criticism and to the ordinary knocks of life born of a protected condition of society, often react through the nervous system upon the chemical organs of the body, preparing the way for arteriosclerosis.

The antidote has been found by those few members of modern society who take advantage of the growing interest in athletics for persons of all ages, the custom of shorter hours, longer vacations, the custom of travel and more reasonable habits of diet.

The author craves the indulgence of protein chemists and bacteriologists whose territory he has invaded in the search for

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the truth about arteriosclerosis, and hopes they will pardon technical inconsistencies that he has risked in an attempt to explain his experience in clinical medicine. The ever-increasing demands of practice have made it impossible to go back, in person, to the laboratory for confirmation. Clinical philosophy has long since yielded the field to the technician, and no mere practitioner would dispute ground with the youngest laboratory man when armed with test tube and statistical facts. But sick humanity is clamouring for relief and will not wait for the technicians to slowly complete their task and in due time bear their treasures of knowledge and present them for use. The sick man says, "Go seize the precious truth and use it now."

Soclinical medicine, either in the hands of reputable or disreputable practitioners, is always anticipating the advance of knowledge.

The needs of physicians who have been trained in other specialties have been kept in mind, and simplicity has been chosen rather than complexity. If the instinct of the teacher has led to the frequent repetition of the two leading ideas of the book (auto-intoxication or accidental sensitization to particular proteins in causation, and the few-protein diet in treatment), he has only to say that the benefits that come to the victims of this dire disease through treatment founded on these principles make him willing to risk much for the sake of pedagogic success.

If anyone should ask why a real knowledge of arterio-sclerosis has been so long in coming, the answer would be, because physicians have taken the *lesion* for the *disease*.

Much description of blood pressure apparatus has been omitted, as being a matter well covered by instrument makers.

Chronic kidney disease and circulatory brain disease are parts of arteriosclerosis and have been given their appropriate attention.

Appreciation is felt of many workers who have contributed to our knowledge of arteriosclerosis, but whom it is impossible always to mention by name. It is needless to say that those who have written their personal opinions have put the author

under a vast debt. He has made free use of his friends in obtaining material and is highly sensitive of their kindness.

In arranging chapters, certain "dry" but necessary details have been put at the last instead of in their logical order, so that they might be reached after interest had been aroused, and not cause the book to be laid aside; also, because the clinical information tends to make such matters as structural and chemical detail seem more worth the effort of analysis.

This volume is an expression in book form of the author's profound interest in a subject that is forced upon everyone's attention by the fact that arteriosclerosis, more than any other condition under the circumstances of our modern civilization, is a menace to the best lives. It is hoped that the fact that this book is the work of time snatched from actual practice, and not a studied treatise, will not detract from its usefulness.

When in Nauheim, I requested Professor Groedel, Dr. Theo. Groedel and Dr. Franz Groedel to give me some contributions for my work from their experience. I wish in this place to thank them for their criticism and help and for illustrations.

LOUIS FAUGERES BISHOP, M.D.

54 West Fifty-Fifth Street,
New York, 1914.

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ARTERIAL SCLEROSIS

I

THE OCCURRENCE AND DEFINITION OF ARTERIOSCLEROSIS

THE man with arteriosclerosis in its full development is familiar to all physicians. The ruddy visitor to our office, with prominent temporal arteries, the shininess of eye and the unmistakable look that suggests arteries, we know only too well. We can guess before he tells us that he has been rejected for life insurance, or has noticed a discomfort in the front of his chest, either after eating or on exertion. We can surmise that he has been a great eater of many protein foods, or has had some severe illness or nervous strain in the past that has rendered him vulnerable to some special proteins. We know that he will tell us that he considered himself a particularly strong person, and that he is much surprised that he, of all men, should find himself out of order. We know that when he is told that he must submit to a few-protein diet and the hygiene of chronic food poisoning, that he will declare he cannot live on such trash. We know that after patient and repeated efforts he will submit, and learn to enjoy the sense of well-being that goes with the restoration of health; and continue as long as necessary to take his medicine, attend to his exercise, and stick to his diet. And further, that he will expend much unnecessary energy in trying to make his perfectly healthy friends do the same.

We know arteriosclerosis as familiarly as we know any person of our acquaintance, but of all diseases it most eludes definition. It has been a theme for the pens of the masters

of clinical medicine; but the pathologists have assumed the right of definition, and have been prone to claim a better acquaintance on account of their final review than the clinicians after long years of daily intercourse.

The term arteriosclerosis, while it has come by use to signify a particular disease, is badly selected for the purpose for which it is employed. Arterial, or even circulatory, degeneration would be a better name if the term degeneration is accepted in its broadest sense.

The derivation of the word arteriosclerosis implies a special form of structural change which, although at the time the dominant change, is not by any means the only factor in the clinical condition. Thus an increase of muscular tissue in the median coat of the blood vessels is not an increase of connective tissue at all, but may constitute the most marked change. And much of arteriosclerosis, the disease, is outside of the blood vessels.

It is necessary to understand that the term refers to a clinical condition characterized by alterations in the blood vessels, ordinarily accompanied by certain changes in the heart and other organs. These changes generally consist of an increase of connective tissue, hypertrophy of muscular elements and a thinning or thickening of membranes.

The deposit of lime salts leading to calcification of the arteries is not essential to arteriosclerosis, and may exist without any evidence of the clinical condition.

Arteriosclerosis may be said to begin as soon as toxic influence or physiologic strain have brought about an alteration in the structure or habitual physiology of the blood vessels. The difficulty of stating in a particular instance whether a man has or has not "arteriosclerosis" is thus apparent. The best one can do is to say, part of the time, that the person has no arteriosclerosis at all, and sometimes that he has it well developed. Between these extremes are those showing the causes of the disease but capable of cure. It must be spoken of as a condition rather than as a disease, and like all conditions it is dependent for its importance upon resulting organic changes and disabilities.

Thus, hypertonic contraction of the blood vessels, so long as the blood vessels themselves are strong and the heart correspondingly efficient, is not of present clinical importance; but if, under the same conditions, the heart is not efficient, then the condition is of importance.

Even in the most advanced stages the bearing of the disease on the individual depends upon the ability of the heart to hold out and the continued functional activity of the kidneys.

These statements and what follows will make clear the meaning of arteriosclerosis, and why the term itself is not susceptible of more exact definition.

Experimental Pathologic Physiology of the Blood Vessels

Nothing is more characteristic of the recent progress of medicine than the development of the experimental method of studying disorders, particularly those of the circulatory system.

A hundred years ago great advances were made in the knowledge of disease through the channels of pathologic anatomy, and in succeeding years disease was classified according to changes in the tissues found after death; this was a work of supreme importance, and twenty-five or thirty years ago had reached a certain degree of completeness.

Following this work in pathology, there has gradually developed the study of pathologic physiology, so that almost imperceptibly this has followed, and, in a measure, superseded the study of pathologic histology. In circulatory disease it has brought new light and has given new hope and inspiration in treatment.

A classification of arterial lesions, "Lectures on Practical Medicine and Pathology," as taught me by Francis Delafield, M.D., LL.D., 1894, following the school of pure pathologic anatomy, was as follows:—

"Chronic Arteritis:

"*Synonyms.*—Arterio-capillary fibrosis, arteriosclerosis.

"*Definition.*—A chronic productive inflammation of the walls of the arteries, which involves principally their inner and middle coats, and is often accompanied by degeneration.

"*Lesions.*—This form of inflammation occurs most frequently in the aortic system of arteries, but it is also seen in the branches of the pulmonary artery. Only a part of the aorta is involved, or the whole of the aorta, or the aorta with most of its branches, or the arteries of some particular part of the body.

"There is often chronic productive inflammation of one or more of the viscera.

"1. *The Small Arteries.*—(*a*) The simplest change in the small arteries is an increase in the size and number of the endothelial cells.

"This is best seen in the arteries in miliary tubercles and in the small gummata.

"(*b*) There is a growth of new connective tissue from the endothelium, which encroaches upon the lumen of the artery and finally occludes it. The growth forms a ring on the inside of the intima, thicker in some places than at others.

"(*c*) There is a thickening of the inner coat beneath the endothelium. The lumen of the artery is irregularly narrowed, while in other places the wall of the artery is thinned. Besides the thickening of the inner coat, the middle and outer coats may also be thickened.

"(*d*) The whole wall of the artery is thickened and replaced by dense connective tissue.

"2. *The Large Arteries.*—In the large arteries altogether the most frequent change is the thickening of the intima. This is often present in arteries which look normal to the naked eye. Besides the thickening of the intima there is often, in addition, a thickening of the middle and outer coats, or a replacement of the muscular coat by connective tissue. When all the coats are thickened in this way the arteries are often elongated and tortuous. Occasionally there are areas of degeneration in the thickened wall of the artery, or even infiltration with the salts of lime.

"3. *The Aorta.*—The changes in the aorta differ from those in the arteries by reason of the combination of degeneration and necrosis with the growth of new tissue due to the chronic inflammation, by the frequency of calcification, and by the liability of the outer coat to purulent infiltration. We find, therefore, in the aorta:—

"(*a*) Simple thickening of the inner coat by new connective tissue.

"(*b*) Degeneration and softening of the inner and middle coats.

"(*c*) Calcification of the inner and middle coats.

"(*d*) Infiltration of the outer and middle coat with pus cells.

"(*e*) Thinning and atrophy of the inner and middle coats.

"(*f*) The formation of thrombi on the roughened surface of the inner coat.

"*Symptoms.*—It must be admitted that we find the lesions of chronic arteritis far advanced in persons who have never given symptoms referable to the arteries. It must also be admitted that chronic disease of the lungs, heart, liver or kidneys is so often associated with chronic arteritis as to obscure the clinical view. But allowing for all these, there remains a large class of cases in which chronic arteritis is the disease."

The description of the arteries in Russel's "Arterial Hypertonus, Sclerosis and Blood Pressure" is typical of the physiologic school, and I venture to quote it.

"Arteries consist of three coats: the external coat, or *tunica adventitia*, is formed of connective tissue in which there are nerves, lymphatics, vasa vasorum, and in addition a considerable layer of elastic fibres next the media, not commonly described; the middle coat, or *tunica media*, is formed of unstriped muscle fibres, which run transversely and thus surround the vessels; the internal coat, or *tunica intima*, is formed of a layer of polygonal endothelial cells with a fine line of subendothelial connective tissue underlying them. In some of the arteries there is an elastic lamina between the internal and middle coats, and another between the middle

and external coats. These are known respectively as the *internal and external elastic laminæ*; they are by no means constantly present, and often only the internal one is represented. In the large arteries the middle coat is made up to a great extent of elastic fibres.

"The arteries are supplied with nerves, which connect them with the vasomotor centre in the medulla.

"The muscular tunic of arteries has, like muscle everywhere else, what is known as *tone* or *tonus*. This is a sustained measure of contraction of its individual fibres, which may be increased or diminished. It is commonly taught that it is regulated by nervous influences conveyed through the sympathetic, the constrictor fibres of which, when stimulated, lead to an increase of tone, or even to a distinct degree of abnormal arterial contraction; while the withdrawal of sympathetic action leads to a lowering of normal tone, or to a definite relaxation of the arterial wall.

"While the tone of the arteries can be thus controlled by the sympathetic, there is the authority of Leonard Hill for the observation that it is soon restored after section of the vasomotor nerves. The tone under such circumstances is regarded by him as being then maintained by the blood pressure. It will be subsequently shown that another factor has to be taken into consideration when tone is lowered or increased, as it is in disorders which come under the notice of the physician.

"In considering the movements of arteries, it is to be noted that they have firstly a *pulsatile movement*—probably a rhythmical response to the rhythmical flow of the blood, corresponding with ventricular systole and diastole. It is probably not merely the stretching and contraction of an elastic tube by a wave passing along its contained fluid, but the same kind of unceasing rhythmic movement the heart possesses. However that may be, it is important to divest our minds of the current notion that the arteries are a mere system of elastic tubes.

"In addition to the pulsatile movement, there is a further movement which is allied to tone, and yet is such an abnormal

exaggeration of it that the terms *contraction*, *constriction* and *spasm* have all been applied to it. Although occasionally recognized, it has been to a great extent ignored in clinical medicine, and its significance has, as an inevitable consequence, been overlooked. The thought of 'blood pressure' has possessed the field to the practical exclusion of the arterial wall.

"The accentuation of the normal movement is of great clinical significance, and as it varies within wide limits it is desirable to have words or terms to express the differences. The normal degree of tonicity varies, and it varies under conditions which are to be regarded as normal. It is therefore impossible to do more than have a somewhat empirical nomenclature to define its variations. What is of practical importance is to know that the tonicity does thus vary; to be able to recognize differences when they are present, and to understand that such variations are no mere chance phenomena without cause or significance. The *normal tonicity* or tone is to be noted in the soft vessel of perfect health. This tonicity is increased under physiological conditions, as during digestion and during physical effort. This is a physiological hypertonus; no other term expresses the fact; it is an increase of a normal state due to an increase in the intensity of normal stimuli. The term *hypertonus* has sometimes been objected to since I introduced it in this connection, but a word was required that would carry the idea which has been indicated. When the hypertonus occurs in an artery the increased measure of contraction of the muscular coat, which is necessarily implied, means that the wall of the vessel becomes somewhat thicker, that its diameter is somewhat reduced, and its lumen correspondingly diminished. The degree of contraction may exceed the limits of normal variation, and when it does so, the term *hypertonic contraction*, or merely *arterial contraction*, will be used here. The word *contraction* has such a variety of meaning in medicine, and so commonly means a narrowed orifice or a strictly limited constriction in a tube, that it requires the adjective *hypertonic* to indicate an effect which is wider and more generalized

through the arterial system. The term *hypertonic contraction* will therefore be used to indicate this greater degree of arterial constriction. There is yet another condition, differing from the preceding in being a *localized constriction.* In the two preceding conditions, the 'hypertonus' and the 'hypertonic contraction,' the contraction affects the whole systemic system. In the third condition the arterial constriction is localized, and may be so extreme in degree as to greatly diminish or completely shut off the blood flow in the affected vessels; to this condition the term *arterial spasm* is most suitably applied, and will be confined in these pages. It will from this be realized that the morbid is but an exaggeration or an intensification of the normal process. The reverse of hypertonus is loss or diminution of tone."

Some writers find fault with the widening of the term arteriosclerosis to include more than the well-developed lesions and palpably thick arteries, but, as we are dealing with sick men and women, the clinical disease that gives birth to the beautifully uniform thickening of the arteries cannot alone be considered; and sometimes changes in important organs precede this structural change.

The changes in the organs and the changes in the arteries we believe come from a common toxic cause, and that the changes in the arteries are not due merely to disturbance of blood supply.

The changes in the arteries begin in the middle coat or muscular coat, which at the same time is usually hyperactive and often hypertrophied by the mechanical demands of an attendant compensatory high blood pressure.

Elsewhere we touch upon other theories, some of which, unfortunately, have led to harmful plans of treatment.

There is almost common consent among writers as to the existence of the intoxication element in causation, but all have not carried their belief to logical conclusions in treatment.

Current literature abounds in statements as to the great recent increase in deaths from cardiovascular disease, *e.g.* 100 per cent. in 30 years.

Everyone must have seen some examples of the development of arteriosclerosis in comparatively young persons. Very little consideration shows that the type presents differences from that of older people.

Though it is not always possible to trace the cause, some form of poisoning is to be strongly suspected.

Of those recently under observation, one instance was that of a young man employed in a shop where electric appliances were manufactured, and it was difficult to discover exactly what was the nature of the poison, but lead was strongly suspected, and it certainly was, in all probability, some form of metallic poisoning.

Transient attacks of aphasia and paralysis are frequent in states of very high blood pressure in arteriosclerosis. Of these transient aphasia is one of the most common symptoms, and scarcely any person with advanced arteriosclerosis escapes a slight transient attack, though it may not be recognized unless one is on the lookout for it.

When the condition is marked it causes great alarm, and naturally leads to the question whether it is a forerunner of paralysis. Fortunately, this is not always the case, and complete recovery takes place, though there may be paræsthesia for quite a while.

Transient hemiplegia is not so common in my experience as simple aphasia, though it is less apt, of course, to be overlooked. These conditions we attribute to spasm of the arteries and anæmia of the parts supplied.

At this late day it should hardly be necessary to recall to the reader of a work on arteriosclerosis that atheroma must not be confused with arteriosclerosis. The whitish or yellowish plaques seen in the aorta and larger arteries have no great significance, nor must the changes of advancing years without symptoms be confounded with arteriosclerosis. Huchard says:—

"Everywhere we see the same misuse of the term arteriosclerosis.

"The mistake is especially nosological, as will be seen. A disease that remains limited to one organ, which does not

tend to invade other organs, which is never accompanied by toxic accidents due in particular to renal insufficiency, free as a rule from any change in the blood pressure, which often spares both the heart and the kidneys, which supervenes mostly at an advanced age of between sixty and eighty, is not arteriosclerosis. I will even go further, and say that if this occasionally coexists with the presence of lacunæ we must regard them as two diseases essentially different in their nature, in their mode of clinical evolution,—in fact, two absolutely fortuitous morbid associations without any causal relationship."

It is not possible to make any satisfactory classification of clinical importance that is founded upon purely anatomical grounds. The true pathology of arteriosclerosis must be a moving pathology, and the structurally disordered body that has undergone a suitable physiologic adjustment is better than a body that shows much slighter structural change but which lacks an adjusted physiology. It is a truism in cardiovascular disease, that the greatest damage is often compatible with a longer life than the least structural change when the latter lacks compensation.

II

THE RIDDLE OF ARTERIOSCLEROSIS AND THE AUTHOR'S SOLUTION

The theory of arteriosclerosis that will be found woven into the web of this book, and its logical conclusions in dietetic treatment, are not the result of sudden inspiration, but are the outcome of prolonged consideration. The primary fact that is accepted by all thoughtful writers on this topic, as is abundantly shown in the chapter of "Opinions of American Physicians," is that the changes in the arteries must not be mistaken for the disease itself. The point of this remark is best appreciated by an illustration.

Suppose some disorder, like a business panic, should attack everybody in a whole nation, and someone who did not know of the trouble should take a bird's-eye view of the country. One of the most conspicuous things that would be noticed would be that the railroad system was not in its usual active operation. If the paralysis of business lasted long enough the rails would commence to rust, repairs would not be made, and the whole interweaving system of tracks throughout the country would show a distinct change from normal. So a superficial observer might blame the railroad system of the country for the bad condition of the whole, while in fact the real trouble was in the individual inhabitants.

It is the same way with arteriosclerosis. It is really a disease of the cells of the whole body, but the circulatory system pervading every part of the body, more than any other, is the one that shows the most conspicuous result of the damage that really begins in the ultimate cells. This primarily is a perversion of function, and what we really know about various organs must be expressed in function.

The changes in structure are the result of perverted function. There are a few rare examples of disorders of the arteries that consist of a true local inflammation, but that has nothing to do with the vast majority of persons who develop this condition and present the picture so frequently referred to as premature ageing.

Granting the acceptance of this broader view of arteriosclerosis as being a functional disorder of the individual cells of the body, we need another conception to carry us further, and that is of the nature of function of the cells. The function of the cell is becoming more and more recognized as dependent upon changes that fall within the domain of bio-chemistry. One function of the cell is to nourish itself on surrounding material, and seems to reside in certain enzymes.

In the human body enzymes modify the relation of the cell to its surrounding blood plasma. It is not necessary here to refer to modern observations on immunity, etc.

My own belief is that arteriosclerosis arises when the cells of the body become sensitive to particular proteins, and that these proteins create irritation, something in the nature of a mild anaphalaxis, and if this is continued over a long period of time the result is changes in structure which constitute the disease known as arteriosclerosis. The circulatory organs, like the railroads of the country referred to in the simile, show the most striking changes.

The first step in the study of arteriosclerosis is the absolute distinction between the results of this disease in the arteries and atheroma. The next step, and a much longer one, is the conception of arteriosclerosis as a general disease of the cells of the body which does not spare any structure and rises to the degree where there are symptomatic manifestations, now in one place and now in another.

Recently I spent an hour in reviewing the condition of a prominent physician who is suffering from recurrent attacks of violent pain of arteriosclerotic origin. He knew very well that he was suffering from arteriosclerosis, but he was very much surprised when I told him that his pain arose

from changes in the tissues involved, arising from the same cause as the changes in his arteries, but that I did not believe that the arterial changes were the cause of the pain.

A great step has been made towards the acceptance of the truth concerning arteriosclerosis in the universal belief in its toxic origin. Most of the views of physicians published elsewhere contain this idea. In placing as I do the usual cause of poisoning in special animal proteins to which the particular individual cells have become sensitive, I do not mean to assert that this is the only cause. While the great majority of persons respond magnificently to the discovery and withdrawal of their protein poison, there are a few in whom further search is necessary. In these sometimes a focus of suppuration or an unrecognized lues or some other reason is discovered. Sometimes, however, time develops the fact that there has been a departure, conscious or unconscious, from the prescribed diet.

Huchard's definition is as follows :—

"A disease not so much generalized as disseminated, occasionally localized, but with a constant tendency to spread." It is characterized anatomically by visceral sclerosis consecutive to the arterial lesions; this lesion may first attack the aorta and even the valvular apparatus of the heart, though commonly only vessels of medium and small calibre. Clinically it is manifested by toxic symptoms giving rise to vascular spasm and variations of arterial tension, dyspnœa and insomnia, tachycardia with or without any arhythmia, vertigo and cerebral disturbances." In this definition I would substitute the word coincident for consecutive.

In thus placing the cause of arteriosclerosis outside of the circulatory organs we do not mean to imply that it is not necessary to treat the disorders of the circulation that arise; the disturbance of function in the heart, the hypertonicity of the blood vessel and the functional failure of the kidney must get their appropriate attention.

The heart complications of arteriosclerosis consist of the most varied disturbances of the function of the heart muscle that are seen in any disease, and there is no form of

kidney disease that does not at one time or another arise in connection with it.

From the quotations of many authors that will be found scattered throughout this book, it is apparent that arteriosclerosis may be termed a riddle of the ages.

It is apparent to anyone who has the least experience in the world that some people grow old much quicker than others—that many die before their time from a particular trouble known under various names, but which of late years has been called arteriosclerosis. No one has known quite why this develops. One thing and another has been blamed, not the least indefinite of which we expressed in a term that always seems modern, but which is found in literature of all times, that is, "the increased complexity of modern life."

The causes of disease have not changed, though their frequency has varied, and unless we can find some element in the increased complexity of modern life that is different from other times we will not find here the key to the riddle.

Things that are incomprehensible seem very mysterious, and yet when they are explained they are easy enough. I remember one summer that a magician came to our hotel, and, taking a pack of cards, he passed rapidly around the room asking each person to draw a card, and then with much ceremony he proceeded, by a process of mind reading, to tell each person what card he held. Everyone was much mystified, and as I had always been much interested in conjuring tricks, and could not understand it, when I got back to the city I looked up the literature of tricks and discovered and learned how to perform the feat, for, of course, all such performances are tricks. I found that there was a little mnemonic poem that could be learnt by which one could memorize the order of all the cards in the pack, and that by slipping out the next card to the one each person took, there was a perfect key to each one's card. The thing seemed so mysterious when it was done and so easy when it was understood, that it offered a valuable example of the simplicity of riddles when once the key is discovered.

That there is a key to the riddle of arteriosclerosis we

must believe before we can hopefully seek for it. The literature of arteriosclerosis, unlike the literature of card tricks, does not afford an exposition. It must be sought for elsewhere, and I believe is to be found in the still obscure field of protein bio-chemistry. And I believe in the end it will be discovered that the reason for the perfectly apparent increase of arteriosclerosis of modern times is to be found, not so much in the supposed increased complexity of modern life, which is not as much a fact as we believe, but in the well-known changes with regard to the habits of people in connection with protein foods and the different manner in which they are handled commercially, together with some factor or factors yet to be analyzed that render food idiosyncrasies of a low grade, producing unconscious poisoning, more common.

To the student of medicine, with imagination (and what progress is possible without that faculty ?) the whole domain of disease is covered by the territory in which anaphylaxis and immunity are at present the most conspicuous members.

As I am writing this chapter I have in my hand an article by Professor Victor C. Vaughan,[1] who has been so much a pioneer in food study, in which I find reiterated the idea which I have already referred to in this chapter. He says: "A volume might be filled with citations of cases of food and medicine idiosyncrasies. That these are, in large part at least, instances of protein sensitization has been demonstrated by rendering animals susceptible to the same food or medicine by injecting them with the serum of the susceptible individual. In other words, passive anaphylaxis has been established in the animal. In this way Bruck has sensitized animals to iodoform and antipyrin with the sera of persons especially susceptible to these agents."

The key to the riddle of arteriosclerosis I believe lies in just this sensitization of individuals to particular proteins, or, to be more specific, to split products of particular proteins. The technical details must be worked out by painful stages and long years of special study. Fortunately, the individual

[1] *Am. Journ. Med. Sc.*, Phila., 1913, February.

living at the present time does not have to wait for this completeness in knowledge, as abundant clinical experiment in my hands seems to prove that, with regard to arteriosclerosis, we have in the few-protein diet the means of escaping the consequences of our acquired sensitiveness to any of the proteins that we thereby exclude.

In our writing we speak of the protein as a whole and the individual, but what really counts is the relation of the cells of the body to the protein derivative in the form in which it reaches them. The human body, as a system of organs, has the power of digesting food, and in addition to this the individual cell must have the power of elaborating ferments which split up the pabulum within their reach.

Vaughan says, in the article already quoted, "the cell which can no longer supply a digestive ferment is already dead, whatever be the kind or amount of pabulum surrounding it. The cell which supplies only such ferments as cannot digest the food supply within its reach dies immediately." This is the fundamental fact of the general immunity possessed by higher animals against the lower forms of life."

More strictly bearing upon our own subject is the following in the same article: "The great lesson which we have learned from our studies of anaphylaxis is that the digestive secretions of body cells may be developed and modified by the kind of protein brought into contact with them. When a foreign protein is introduced into the animal body, certain cells develop a specific digestive ferment, which splits up that protein and no other. Cellular digestion is a physiological process and it is normally specific, inasmuch as the secretion of each kind of cell splits up the pabulum in such a way as to supply the needs of its own cell, but the pabulum upon which the cells of the body normally feed consists of the proteins of the blood and lymph. From these sources all the cells of the body select their food material through the agency of their digestive ferments. Normally, there is much preparation of the foods upon which the cells of the animal body feed. The proteins taken into

the alimentary canal are broken up by the digestive juices into amino acids, and in this process they lose all their distinctive character. During absorption or soon thereafter the amino acids are put together again, but now so grouped as to form the proteins peculiar to the species. From the special proteins, thus prepared, each kind of body cell obtains its nutriment. Parenteral digestion is a physiological process in which the material acted upon, the cleavage agents and the assimilating cells are constant. However, even with all this preparation of food for the body cells it must happen at times that foreign proteins, as such, find their way into the blood and lymph. In order to digest this unusual pabulum the body cells elaborate a specific ferment, which digests this protein and no other. This is one of the fundamental and central facts of protein sensitization.

"The second fundamental fact in protein sensitization is that every protein molecule contains a poisonous group. This is true of all bacterial, vegetable and animal proteins, so far as they have been investigated. The poisonous group in the protein molecule is the same so far as its physiological action is concerned, whatever be the nature of the entire molecule of which it is a part. Chemically, there must be differences in the poisonous groups of different protein molecules, but, as has been stated, in physiological action one cannot be distinguished from another. It may be that more exact studies will show slight variations in physiological effect. I have designated the poisonous as the primary group in the protein molecule. I have also suggested that it be regarded as the 'archon' or keystone of the protein molecule. It probably contains the benzol ring with nitrogenous side chains. Attached to this primary group are secondary groups which may be designated as the 'characteristic' groups, because it is in these that one protein differs from another. The sensitizing properties of proteins reside in the secondary groups, because it has been shown that these when freed from the poisonous group may sensitize animals to the unbroken molecule. It is for this reason that the special ferments elaborated in the cells of

the animal under the influence of a foreign protein are specific. The poisonous group, when detached from its secondary or characteristic groups, does not sensitize either to itself or to the whole protein from which it came. In the original protein molecule the poisonous group is rendered inert physiologically by being combined with the secondary groups. In its free state it becomes a poison on account of the avidity with which it disrupts other protein molecules and combines with their secondary groups. The protein molecule may be compared to a basic or neutral salt, and it becomes more and more poisonous as its basic elements are removed, and when the free acid only is left its maximum toxic action is reached. The protein poison is a powerful agent. In the purest form in which I have been able to obtain it, and this probably is far from chemical purity, it kills guinea-pigs of from 200 to 300 grams weight, when injected intracardiacly in doses of 0·5 milligram. When used intra-abdominally this dose must be multiplied by 16; and when given subcutaneously, by about 32. These differences in effect according to the method of administration are of importance, and are accounted for by the fact that the poison attacks and is neutralized by the body proteins with which it first comes in contact.

"Whenever neutral proteins undergo cleavage as the result of the activity of proteolytic enzymes, there are steps in the process when the activity of the poisonous group is made more manifest, and this proceeds as the basic elements are stripped off. In this way the poison is in part liberated in alimentary digestion. Biedl and Kraus have shown that the action of the anaphylactic poison and that of pepton are identical. This is necessarily true, because the active group in both is the same. The protein poison is set free or activated by the alimentary proteolytic enzymes, and if it were a readily diffusible substance all proteins would be poisonous to man when taken by the mouth. But since it does not speedily pass through the alimentary walls, and since additional cleavage renders it inert, we escape its poisonous action. In parenteral digestion of proteins there

are no walls to prevent diffusion of the poison, and consequently more or less injury always results.

"Anaphylactic shock is such a striking phenomenon that for a long time it obscured the essential facts of protein sensitization and led investigators far astray. When compared with immunity, the two seemed antipodal; in one the life of the animal is saved, in the other it is jeopardized and in the majority of instances lost. Indeed, it was a misconception which led Richet to select the term 'anaphylaxis.' I still hold to the following statements concerning protein sensitization first formulated by Wheeler and myself.[1]

"1. Sensitization consists in developing in the animal a specific proteolytic ferment, which acts upon the protein that brings it into existence, and no other.

"2. This specific proteolytic ferment, stored up in the cells of the animal as a result of the first treatment with the protein, remains as a zymogen until activated by a second injection of the same protein.

"3. Our conception of the development of a specific zymogen supposes a rearrangement of the atomic groups of the protein molecules of certain cells in the animal body or an alteration of the molecular structure. In other words, we regard the production of the specific zymogen not as the formation of a new body, but as resulting from an alteration in the atomic arrangement within the protein molecule, and a consequent change in its chemism.

"4. Some proteins, in developing the specific zymogen, produce profound and lasting changes in molecular structure; while the alterations induced by others are slighter and of temporary duration, the molecular structure soon returning to its original condition."

Simple as this seems, it requires careful re-reading before its tremendous significance becomes clear. I have used Vaughan's words because he has been so much a pioneer in food studies, and because as a clinician and not a laboratory worker I must be satisfied if I can explain how the riddles are solved, though I cannot solve them myself. If I can in

[1] *Journ. Infect. Dis.*, 1907, iv. 476.

a measure stand between the laboratory and other clinicians in making a practical application, my greatest expectations will be realized.

Another point brought to mind may have some bearing upon the relation of the unfriendly protein to the cause of arteriosclerosis as the effect of protein in causing fever. This is referred to above. It has been found that very large quantities of protein injected do not cause fever, while smaller quantities do cause fever.

With regard to protein food, there must be some such relation to account for the great diversity of successful diets. The same persons may do well when deprived of a particular protein; they may do well when fed exclusively on this protein and very little else, but they may do badly when this protein is taken in the usual quantities as part of a mixed diet. How this apparent paradox may be explained the future will determine.

It is a fact that a person may sometimes overcome a food idiosyncrasy by the persistent large use of this food, while if the food be taken in only moderate quantities the disagreeable symptoms persist; on the other hand, a person may be sensitized to a food by its abuse.

This is the exposition of the riddle of arteriosclerosis, and the key to the riddle is in the few-protein diet for all those who may be sensitive to proteins in such a way as to lead to arteriosclerosis.

It would be very interesting if we could decide whether infectious diseases can give rise to a sclerotic process that will, by its own momentum, continue and increase after the infectious disease has ceased. This is the picture that many physicians have of the arteriosclerosis caused by infectious disease. If this is the case, why should it not be so in every instance of arteriosclerosis?

Many have observed examples of arteriosclerosis in young people following toxæmia of some kind that has practically disappeared in the course of time. Connective tissue becomes more dense by time, but unless some other disease is added it does not increase according to the experience of ordinary

scar tissue, which indeed, after a long time, not only becomes less but softer.

In spite of this general feeling that sclerosis does increase by its own momentum, it seems to me very much more probable that the increase of sclerosis is due to a continually acting cause, which I believe will be found in the irritation of the cells by a protein to which they are sensitive.

Another theory with which the sensitization idea comes in conflict is the idea of toxins having their origin in the intestinal tract as a result of intestinal putrefaction. A certain amount of intestinal putrefaction seems to be natural, and the body seems to be provided with means of defence against damage from it. Undoubtedly an intense putrefaction does overwhelm even a healthy body, but it seems probable that a sensitiveness is necessary for the moderate degree of intestinal disturbances found in arteriosclerosis to cause the profound damage that results. It is not possible at this time to put aside intestinal putrefaction, but we are only willing to concede it as a factor in a rather complicated process.

The following note is from the Journal of the American Medical Association.

"Despite the obscurity and uncertainty which still attend the interpretation of many of the striking features of the phenomena spoken of under the term anaphylaxis, the study of these responses has already been full of fruitful suggestions in various domains of pathology. It has furnished a working basis for the investigation of hitherto obscure manifestations of diseases like asthma and hay fever, and has given clues to potent possibilities in the direction of treatment or prophylaxis. Among the newest indications of the rôle which this unique hypersensitiveness and the consequent anaphylactic reactions may play is their suggested relation to certain types of heart-block or disturbances in the co-ordination of the heart-beat. Dr. John Auer,[1] of the Rockefeller Institute in New York City, has described peculiar anatomic changes in localized

[1] Auer, John, "Anaphylaxie als eine Ursache von Koordinationsstorungen des Herzschlags beim Kaninchen," *Zentralbl. f. Physiol.*, 1912, vol. xxvi. p. 363.

portions of the heart musculature in rabbits which have succumbed to an anaphylactic seizure after being sensitized with horse serum. Since these transformations involved some of those portions of the heart which are known to be concerned with its conduction processes, it seemed possible that under these conditions the organ might show an upset in the co-ordination of the beat.

"This is precisely what Auer found. Disturbances in the cardiac rhythm attended not only the fatal cases of anaphylaxis, but also some of those in which recovery supervened. The behaviour of the heart in these instances was comparable with what is observed in cases in which there are marked inequalities in the number of auricular and ventricular beats, so that 3 : 1 or 2 : 1 rhythms, for example, become established. Added interest centres in the fact that similar muscular alterations are observed in the heart after administration of lethal doses of digitalis, strophanthus and other poisons. The relation of these substances to disturbed heart rhythm is known; and it is not at all unlikely that the heart-block which they have been observed to occasion may be attributable, as in the case of anaphylaxis, to morphologic changes which the drugs induce in the cardiac tissue. At any rate, there is food for reflection in the analogies presented."

III

THE CAUSES OF ARTERIOSCLEROSIS

The causes of arteriosclerosis have been a matter of debate for many years,—indeed, ever since it has been recognized as more than a developmental condition. In the chapter of "Opinions of American Physicians" some interesting speculation may be found, but practically all over the world the condition that is known as auto-intoxication is spoken of as one of the causes. Syphilis has a place of its own, and also the infectious diseases, with lead poisoning. Auto-intoxication must not be limited, as it sometimes is, to that of intestinal origin.

Intestinal putrefaction has received much consideration in relation to cardiovascular disease in the last twenty years, but it has yet to receive the study that will place it on a definite basis. Unfortunately, it has sometimes been brought forward, particularly in the past, in a manner that has aroused opposition and has led to rejection without examination. This often happens to theories that come dressed in the garb of popular science rather than in a more formal way.

Thus some eminent men have found themselves in the position of having denied a theory without sufficient consideration, and therefore, later, have ignored it entirely.

There is, however, a consensus of opinion that arteriosclerosis is caused by some toxic influence.

After giving due weight to infectious diseases, metallic poisons and to sclerosis of the aorta from labour, we still find a need for a greater cause for the remaining majority of cases. There is a class characterized by the presence of

indican in the urine. Indican of itself has no special significance, but it is the index of other products of putrefaction. It gives us an easily recognizable and measurable symptom. In that it requires intelligent interpretation, it does not differ from other symptoms.

When, in the presence of an excessive protein diet, the abuse of alcohol, or depressing nervous causes, intestinal putrefaction begins, arteriosclerosis is threatened.

In all persons it does not develop in the same way. In some, the arterial condition reaches a high degree of advancement without conscious symptoms.

In others, the kidneys suffer early in the disease, and blood pressure is raised, with the usual sequence of high blood pressure discomforts and heart symptoms.

In the third group, the primary effect of the poison is to involve the musculature of the heart and blood vessels, together with the brain and nerves, so that the subject has all the symptoms of neurasthenia with low blood pressure. This is accompanied by a slight albuminuria, and naturally suggests the impairment of function of the kidneys. In these, at first the arteries seem to escape, but if the poisoning continues the damage to the kidneys becomes greater, low blood pressure passes into high pressure, and the picture of chronic Bright's disease gradually appears.

The idea of food poisoning is an old one in medicine, and has led to much reliance upon purgatives, but bacteriology and chemistry have made definite what before was not even known to speculation.

There are some striking facts with regard to waste materials in the intestines. In adults the contents of the rectum are 40 per cent. by weight bacteria, the remainder being undigested food, fatty acids and mucus. These bacteria are often classified into aerobic and anaerobic, the latter being putrefactive and thriving only away from free oxygen. There are few bacteria in the stomach, as they are killed by the gastric juice. The same is true of the upper end of the small intestine, though even here they commence to increase and are fairly abundant at the lower end of the small

intestine. It is in the colon or large intestine that bacteria multiply to countless millions. The anaerobic or putrefactive bacteria are few in the upper end of the large intestine where the aerobic are found, streptococci being conspicuous. In the colon are found, in addition to the ones so prominent above, large numbers of anaerobic germs.

An important matter is the fact that anaerobic bacteria do not thrive and cause putrefaction in an acid medium; while the aerobic, such as the streptococci and colon bacillæ, are beneficent in that they prevent alkalinity of the intestinal tract, and so discourage the germs of putrefaction.

This fact has given a key to the treatment of intestinal putrefaction in the administration of germs that cause lactic acid fermentation, but experience shows us that the mere swallowing of these germs is not sufficient.

The chief pernicious activity of the anaerobic germs is in breaking down protein substances with the production of toxic agents, the most easily detected of which are indol, skatol and phenol. So the elements that favour intestinal putrefaction are the presence in the intestinal tract of protein material, an alkaline reaction and an excessive number of anaerobic germs of putrefaction. In treatment these elements are combated separately.

When indol has passed through the liver it is found in the blood in the form of indoxyl potassium sulphate. In this form it appears in the urine. As frequently reiterated before, an excess of indol is a convenient index to a group of toxins which, under conditions of intestinal putrefaction, are absorbed into the circulation.

When the kidneys are defective, instead of being promptly eliminated, these substances are retained. Under these circumstances their presence naturally becomes of great importance.

It is easy to see, from what has been said, that indicanuria must be an occasional occurrence in all individuals who are not absolutely regular and simple in their lives.

When we speak of intestinal putrefaction and indican-

uria in the important connection of arteriosclerosis we refer to a persistent phenomenon.

Though intestinal putrefaction is a condition often without symptoms, there are certain things that are so frequently seen accompanying it that, though usually ascribed to other causes, they are worth noting—headache, neuritis, neurasthenia, anæmia, dyspepsia, alternating diarrhœa and constipation, and depression of spirits. In some these conditions are called malaria; in others biliousness. As a transient condition, these symptoms are often improved by purgation and a plain diet, but in true intestinal putrefaction they are very persistent.

The rôle of the germs does not seem to me as plain as many writers assume. They undoubtedly play their part in breaking down protein molecules, but the way the bodily organization handles the resulting poison groups is really the important matter. Every healthy body can deal successfully with most poison groups of protein derivation in small quantities. It would seem that it is only when the tissues have become sensitive to certain protein split products that they react in a way that is harmful. The assumption that all bacterial decomposition of food is harmful to all people is not borne out by experience; nor are people harmed in proportion to the amount of intestinal putrefaction.

So slight putrefaction and a healthy individual result in no damage. Much putrefaction and a healthy individual result in a little harm, but if the individual is sensitive to the products of putrefaction the damage is in proportion to the amount of the damaging products.

Nor is the sensitive individual free from the danger of damage from the protein groups of ordinary protein digestion when bacterial action is not abnormally present. In this light, the treatment of putrefaction becomes of relatively less importance as compared with the discovery and withholding of such foods as contain the protein to which the particular person is susceptible—a strong argument for the few-protein diet.

Then the question of proteins foreign to the blood

gaining more or less direct entrance into the circulation through defects in the organs of digestion is always to be remembered.

Anyone who has studied the life-history of many of those with arteriosclerosis cannot be unmindful of the fact that food is a factor in many, and the prime factor in not a few.

The sequence of events, beginning with over-ingestion of food, causing or ending in arteriosclerosis, may differ in one or another according to the many modifying circumstances, but there is always an intermediate condition necessary. This may very well be the sensitization of the tissue cells to certain proteins or their derivatives. When the sensitiveness is present, in one, it may lead to direct damage to the heart muscle, blood vessels and kidneys; in another, to kidney damage, which in turn increases arteriosclerosis through high pressure damage.

Arteriosclerosis may begin in the abdominal organs under the well-known law, that strain in any part of the body may lead to blood vessel damage.

The importance of excess of food is best appreciated when we call to mind the fact that all food after being acted upon by the digestive organs is absorbed into the circulation and tissues, leaving only residual matter in the bowels. This food must be excreted or destroyed in the body if it is not employed for nutrition; it cannot remain permanently in the body. The kidneys bear the brunt of the labour, and nobly do they respond for a long time. As age advances greater pressure is demanded to enable them to work, and damage ensues in the heart and blood vessels.

When alcohol is used in addition to food, it supplies heat to the body and lessens the consumption of food. Thus alcohol acts, in effect, as so much additional food.

It is necessary for people to understand that over-ingestion of food may be the principal of several causes leading to arteriosclerosis, though there has been no conscious trouble whatsoever with the digestive organs.

Indeed, the converse may very well be true; that a weak

digestion may serve as a protection against this cause of arteriosclerosis. The special sensitiveness to particular foods will be discussed later at greater length.

A typical example of food arteriosclerosis is the hard-working over-fed business man who has never been conscious of his stomach. The man is particularly liable to this outcome who has been able to eat three meals a day with great regularity, on account of the routine nature of his life, and who has never suffered the digestive disturbances and distaste for food that are common to those leading irregular lives. This is another argument in favour of change and travel, if such be needed.

Bacterial poisoning is often referred to in connection with typhoid fever, but one is of little experience who cannot trace arteriosclerosis to many other acute infections. When epidemic influenza was so prevalent, a good many persons were started on the road to arteriosclerosis through this disease. Its evident effect upon the circulation was seen in the loss of vascular tone, and its damage to the kidneys was recognized by many observers. We have seen the same thing follow infections of the tonsil and suppurative conditions in general. It seems to occur quite frequently with chronic tuberculosis, and follows attacks of pneumonia. It should not be forgotten also that arteriosclerosis is one of the sequelæ of rheumatism. In all these instances an intermediate sensitization of the body to particular proteins may be a step.

Attention has often been called to the fact that no part of the human body is subject to so great strain as the beginning of the aorta, into which a pressure wave is thrown by the heart at each beat. While this is true in all persons, the same effect is very much exaggerated in those who do muscular labour, with its accompanying increased heart action and raised pressure; this leads in many instances to an increase of connective tissue, and finally to sclerosis of the aorta. At first the effect is only upon the aorta itself, but when degeneration has begun the disease travels backwards and is apt to involve the aortic valves. Usually in the same

individuals a more general arteriosclerosis exists, and a resulting high blood pressure. However, few individuals of this type are free from other causes.

Localized arteriosclerosis in other parts of the body subjected to strain have been observed, notably a case told me by Professor Groedel, in which there was a localized arteriosclerosis of the blood vessels of the arms in a musician who played the piano to excess.

(Local arteriosclerosis occurs in the brachial arteries mostly of men who have to work much with their arms, whereas in a better class of people, not working much bodily (with their arms), the radial artery very seldom shows a high degree of hardening.)

The involvement of the aorta particularly is seen quite frequently in hospital practice among labourers who do heavy work. However, it is hard to prove that muscular strain is the only, or indeed the principal, cause.

Within a few months I have seen two persons whom I believe owe their arteriosclerosis almost purely to nervous causes; one is a man and the other a woman.

The man was a speculator who had brought so much detailed attention to bear on everything pertaining to the stock market that he had surpassed nearly all his fellows and had succeeded in making a great fortune. He received in his office every day reports from all the markets of the world, and each of his actions was based upon such information.

As a result of this nervous strain, extending over a good many years, he developed a high blood pressure which had gradually damaged his blood vessels, overburdened his heart and impaired the action of his kidneys.

A few months' removal from his occupation and customary surroundings to a foreign health resort had, when I saw him last, restored the equilibrium of his circulation, and, while still maintaining a good deal of his habitual pressure, he had the appearance of health.

The other was a woman to whom worry and anxiety had become habitual, and who had developed a very high blood

pressure; and when I saw her three years ago she was on the verge of one of the terminal accidents of this condition.

She had previously been treated on the theory that she had nephritis, but when treated on the supposition that high blood pressure was the primary condition she made a marked recovery, though she never lost all her high blood pressure. This woman had been subjected to mental and physical strain and had developed an attack of dilatation of the heart.

Arteriosclerosis is always aggravated, if not caused, by worry.

In my first book on "Blood Pressure,"[1] published in 1904, was a chapter entitled "Hypertonia Vasorum Idiopathica," in which I attributed the condition of the blood vessels to worry, and I still believe that worry is a very important factor in production of arteriosclerosis.

However, a great deal of study during the last ten years has been directed toward the physiology and bio-chemistry of disorders of the heart and blood vessels, and leads me to the belief that the effect of worry is less direct than I then supposed.

As a man devoting himself exclusively to heart and blood vessel disorders, and not interrupted by general practice, I have been able also to follow very closely accounts of the observations of others, and have often been at pains to witness their experiments. It seems to me that the nervous element, as a direct cause of disease, must sometimes give place to the idea that there is an intermediate step in the process, namely, a disturbance of the bodily chemistry, which in turn leads to arterial damage.

Just as in disease of the heart we have come to recognize that nervous influences have but little to do with irregularities, so we have also come to find that the tone-maintaining function of the arteries rests in some factor that is independent of the nervous system. The nervous system seems to provide for transient changes in the circulation, but it is very soon fatigued when it is called upon to act directly.

[1] "Heart Disease, Blood Pressure and the Nauheim Treatment," Funk & Wagnalls Co., New York and London.

Thus it comes about that we have a confirmation of the experience that, while sudden emotion may raise blood pressure and cause damage at a particular point, as by a broken blood vessel, continuity of emotion does not raise blood pressure except after a considerable period of time, when the chemical functions of the body have been disturbed. It is perfectly possible to conceive what is often observed, that persons who live in a state of anxiety and lead lives involving great mental tension nevertheless escape arteriosclerosis because of the simplicity of their diet, the regularity of their exercise and the absence of accidentally acquired sensitiveness to proteins.

The influence of extreme anxiety in bringing about a rapid development of trouble in people who are afflicted with arteriosclerosis is so well known by physicians that it hardly needs to be mentioned. Anxiety seems to have the power of upsetting the chemical functions of the body almost more than anything else.

Mr. A., referred to me by Dr. William H. Upton, of New York, was an officer in one of the departments of the city government, which was under a severe investigation by unfriendly examiners of another party. He had been accused by a person supposed to be his friend, and was in a truly pitiable condition of mind and body.

His physician had known of the existence of his arteriosclerosis for a long time, but it had been controllable.

Mr. A. was a large, tall blonde man, weighing 204 pounds, and was forty-four years of age. He had had typhoid fever twelve years previously, and had suffered several attacks of malaria.

He had considered his general health good until two years ago, when on the occasion of some slight indisposition his physician discovered the high blood pressure and had put him on a regimen.

When seen for the first time he had severe and constant pain referred to the lower cardiac region, severe and continuous headache, blood pressure 210 mm. Hg, pulse 100, with a very marked hypertonicity of the blood vessels.

His heart was a good deal hypertrophied and somewhat dilated. The lungs showed the presence of moist râles, and there was an extreme degree of restlessness.

There was nothing to recommend in the way of regimen that had not already been instituted for a good while, and the opinion was expressed that the man's life depended upon the relief of a mental anxiety.

Careful and prolonged study has convinced me of the nervous origin of arterial tension in some persons that may result in permanent damage to the blood vessels.

Along middle life there is a close relationship between the integrity of the nervous system and the healthfulness of the blood vessels. Not only does that compound of anxiety and mental activity, known as worry, cause a primary contraction of the blood vessels, but by interfering with digestion and the other chemical functions of the body it brings about a tendency to toxæmia that hurries forward the blood vessel damage.

I saw a man not long ago with very marked arteriosclerosis, who gave his occupation as a painter and showed very marked evidence of lead poisoning. He was suffering from secondary low blood pressure, with a weak and dilated heart. His liver was swollen and tender, and there was some œdema of the extremities. Evidently the man was in bad shape. His history was a long one, and he had had frequent attacks of lead colic. The radial artery was extremely thickened. A similar condition had terminated fatally about a month previously in my hospital through the failure of the kidneys. This form of arteriosclerosis is frequent in hospital practice, and always gives the same history, showing that lead poisoning is a very definite factor in the production of arteriosclerosis.

In painters who give such very definite histories it is naturally easy to recognize, but one can easily imagine instances of lead being absorbed in small quantities, not sufficient to cause acute poisoning but enough to bring about this result.

Beer is sometimes contaminated by lead, and it might

easily be overlooked as a cause in a beer drinker who developed arteriosclerosis.

In speaking of alcohol, we cannot call it ethyl-alcohol and blame it alone for the damage it has done to the system by beverages of which it forms a part, and, indeed, it is doubtful whether pure alcohol has a marked effect in producing arteriosclerosis.

In so far as alcoholic beverages contain toxic substances that put the kidneys on a strain, they cause damage to these organs, high blood pressure and arteriosclerosis. Pure alcohol, well diluted and taken in appropriate quantities with relation to food, probably would have no such effect.

Hence many drinkers who are also moderate eaters and of a cheerful disposition escape arteriosclerosis while using considerable quantities of good wine. It is not fair to blame alcoholic beverages alone, leaving out the infectious causes, the food causes and the nervous causes; nor is it fair to combine the question of causes with the question whether a man suffering from arteriosclerosis should use alcohol.

Alcohol has a marked influence in disturbing vasomotor tone; it has a marked power of interfering with the oxidation of food, and it is apt to be taken along with various poisons when consumed in the form of alcoholic beverages. For these reasons it is extremely undesirable in arteriosclerosis; still, there are some old people who have passed the sthenic stage in whom it is distinctly advantageous.

Does tobacco cause arteriosclerosis? This is a question upon which there is much difference of opinion and experience.

On general principles, during the treatment of disease, it is better to dispense with all substances having cardiovascular effects. Nevertheless, there are instances where, on account of long habit, we do not feel disposed to enforce this rule as to tobacco without careful consideration.

The effect of nicotine, the active principle of tobacco, is a powerful one, an elevator of blood pressure. Thus people suffering from low blood pressure often feel much better after smoking, though the later effect of tobacco is a lowering of blood pressure.

On general principles a cigar is the least harmful form of smoking. A pipe is stronger, and cigarettes are particularly harmful, on account of the incomplete combustion and the frequency with which they are used.

A large number of people of mature age smoke without any apparent harm. Occasionally, susceptible individuals suffer from weakness of vision, dizziness and nervous symptoms in general.

Young people have a peculiar susceptibility to tobacco, and they suffer from its direct effect upon the heart. Tobacco makes the susceptible heart irritable, irregular and intermittent. Part of this effect is probably due to vasomotor disturbances in the blood vessels.

In people around forty who are subjects of arteriosclerosis these effects are seldom seen, and it is doubtful whether tobacco can be convicted as a direct cause of arteriosclerosis.

So, in the absence of direct experimental proof in the individual case, we come down to an attitude toward tobacco that leads us to forbid it on general principles while allowing it for particular reasons.

There is a distinct group of persons who acquire angina pectoris through tobacco, and who recover when it is withdrawn. They are apparently susceptible individuals, and they always have smoked a good deal.

A hundred years ago gout would have been considered one of the principal causes of arteriosclerosis, but at the present time it occupies only a minor position. There are two reasons for this: one is that we have a wider knowledge and a better understanding of other causes; and the other is that the term gout is used in a much more restricted sense.

Gout of the present day is the particular, definite failure of the chemistry of the body, whereby the formation of urea falls short of completion and insoluble urates are formed instead. These urates circulating in the blood act as irritants, and when they are deposited in the tissue constitute an attack of gout.

(It is possible, as some people suppose, that there is

a functional trouble of the kidneys which makes the secretion of uric acid through the kidneys impossible or diminished.)

In some instances a gouty diathesis leads to the deposit of lime salts and to atheroma of the arteries. In this way the arteries become deformed, and even valvular defects may result. However, pure gout does not ordinarily, at least in America, lead to much shortening of life, or even serious damage to the circulatory organs.

These remarks, when applied to gout as defined above, exclude much that is popularly called gout.

While, for the sake of clearness, each recognized cause of arteriosclerosis has received separate attention, nevertheless several causes are usually active, particularly in the most severe types.

Other causes are apt to be complicated by lack of exercise, by a habit of worry and by over-ingestion of food. Some diseases of an infectious nature, such as typhoid fever, that act with apparent directness upon the arteries, may also have damaged the structure of the kidneys and the relation of the body to accustomed foods, and thus brought about a demand for high blood pressure, and this in turn may cause arteriosclerosis.

The worst are those in which a vicious circle is established by a physiologic demand for high blood pressure, causing damage to the organs of circulation, which in turn require a greater pressure for the circulation of the blood because the vessels are damaged. Such a physiologic demand is found when waste products call for excretion through kidneys which are unable to perform the task.

Slight causes, which acting singly would not be sufficient to produce arteriosclerosis, when reinforced by others may prove as serious as any of the grand causes alone. Thus slight indiscretions of diet with a moderate tendency to nervous tension, when complicated by an attack of influenza, severe tonsillitis or some other infection, may be sufficient to upset the chemistry of the body and cause arteriosclerosis.

When we speak of the "chemistry of the body" we raise the question as to what is the important factor. In old times it meant essentially alkalinity or acidity of the body, which was regarded as constituting different types of individuals. That is a long time ago.

The latest research brings the question down to the enzymes of the individual cells and their relation to the proteins in the blood. The food proteins ought to be disorganized in the intestinal tract and appear in the blood of each animal as its particular protein. If it happens otherwise, there are foreign proteins in the blood, and the cells becoming sensitive to them there is set up something that corresponds to anaphylaxis, and damage gradually results. If we can find out which proteins act in this way and withhold them, we are so much to the good.

The more pronounced and definite the food poisoning of the patient at the time of coming under treatment, the more brilliant are the results, though many of these people have already suffered damage to the arteries.

Mrs. B., referred to me by Dr. A. D. Rockwell, of New York, was fifty-eight years of age, a lawyer by profession, whose father had lived to the age of seventy-nine, and whose mother had died quite young. She had two sisters living. She had never had any severe illness, but had led a life of much hardship and strain.

She complained of shortness of breath, præcordial pain, and had been so suffering for six months, gradually getting worse. Her blood pressure was found to be 170 mm. Hg; hæmoglobin, 100 per cent.; pulse, 100; some cardiac dilatation, and moist râles in the chest.

She was put upon a few-protein diet, with the regular use of castor oil, and was given digitalis.

At the end of a week her pulse had fallen to 84 and was irregular; her blood pressure was 190 mm. Hg; her general condition vastly improved. The first pressure—170 mm. Hg—represented secondary low blood pressure.

The bowels were again thoroughly cleared out, and she continued the few-protein diet. The digitalis at this time

was reduced to one dose a day, and was subsequently discontinued.

By an adherence to the regimen she has gone on very well ever since.

The improvement in the condition of a person suffering from this type of arteriosclerosis is a most striking clinical fact, and the change in physiognomy between the protein-poisoned individual and the healthy colour of the individual when the spasm of the peripheral arteries is relaxed and the blood circulates to the surface of the body is as remarkable as it is pleasing.

There must be a decided clinical relationship between people suffering from arteriosclerosis and those with similar ymptoms, attributed to uric acid, great numbers of whom

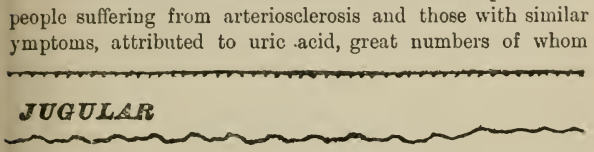

FIG. 1.—Polygraph tracing—Miss J.

Dr. Haig has reported as relieved by a diet not unlike the few-protein diet.

While we would like to assert that arteriosclerosis is always a result of controllable causes, nevertheless the great number of examples following infectious diseases makes it apparent that at best some can hardly escape. We do believe, however, that a careful study of diet after infectious diseases might prevent a good many from undergoing secondary damage.

An example of arteriosclerotic changes following infectious disease was Miss J., forty-three years of age, whose mother was living and whose father had died at seventy of arteriosclerosis. She had five brothers, none of whom had similar troubles. She was a short brunette, with blue eyes, weighing 137 pounds, of high mentality but nervous temperament. She was referred to me by Dr. Edwin Steese,

of New York, to whom she had gone for treatment for her eyes.

She complained of shortness of breath on exertion, with the development of pain over the apex of the heart, and noises in the ears at night.

On examination the heart was found somewhat hypertrophied, a soft blowing systolic murmur; blood pressure was 130 mm. Hg; the urine contained no albumin or casts, but a very decided reaction for indican.

A careful examination into her history showed that she had suffered from diphtheria when twenty-six years of age, and after this had been weak for a long time. She had been treated by iodide of potash and the usual remedies, but had never been upon a strict regimen, and had been restrained of her exercise. At her own instigation she was allowed to take Epsom salts baths, which seemed to benefit her (three pounds of the salts in a bath-tub half full of water for fifteen minutes), but at the same time was directed to adhere to a rigid diet and to take exercise.

The pain in the heart became less, and the general condition improved, so that when she reports once in a few months she is found to be going on all right.

These two examples of arteriosclerosis, the one mild and obscure and the other severe and plain to all observers, both improved on a regimen founded on a belief in their cause being found in a sensitiveness to particular proteins constituting in effect chronic food poisoning. No such brilliant results are obtainable by the few-protein diet—except when coupled with the other treatment—when syphilis is present or when the foreign protein in the blood consists of bacterial proteins, unless the underlying infection can be dealt with.

The study of the cause of arteriosclerosis in each individual is of extreme importance.

VI

THE NATURAL HISTORY OF ARTERIOSCLEROSIS

Natural history is a record of things in language that makes the reader acquainted with the broader character of what is described. To this end mere diagrams, statistics and facts are not enough. There must be anecdotes illustrating characteristics, personal observations and an exposition of the more intangible relations.

Among the most delightful recollections of childhood is the instruction of Prof. Samuel Lockwood, a naturalist and a true lover of nature. His name is little known, for few will probably have occasion to read the natural history of the oyster, in which field he excelled.

To him the natural history of the oyster included its anatomy and pathology, but was something more than that. It was a vivid, interesting story of vital interest. Expounded by the man of science, who was also a humanitarian, a poet and a teacher, the subject became a definite part of important human knowledge.

In the same way the story of the arteries might be made as interesting as Balfour has made the Senile Heart.

But in fact, the natural history of disease is really only learned by each physician for himself. Language falls far short of conveying this knowledge. It can only help the reader to learn from nature.

To trace the development of arteriosclerosis in the life-history of a man who has had many intercurrent disease events, some bearing upon the condition and some not bearing at all, requires careful analysis.

Pure heredity must be distinguished from the passing on of habits of life and exposure to similar causes.

A starting-point can usually be found in an acute illness that has upset the bio-chemistry. The same may happen from the strain of too large quantities of food. Primary kidney disease makes the arteries extremely vulnerable, besides putting a functional strain upon them.

Whatever the cause, there comes a time when there is evidence that the wheels of life are not moving smoothly. There is an unhealthy look, functional nervous disturbances, headache, so-called bilious attacks, perhaps an excess of indican in the urine. Soon a trace of albumin appears, and discomfort in the chest. The stomach digestion, which in the minds of many stands for the chief chemical activity in the body, is often blamed.

The history of those with arteriosclerosis often reveals early in life certain signs of food sensitiveness. Migraine, neurasthenia, gout, biliousness, the severer forms of constipation, heart and kidney disease should put us on our guard. Neurasthenia is often the earliest manifestation of food poisoning. The man who cannot eat eggs without getting a coated tongue is sensitive to eggs, and perhaps other things.

Presclerosis is a valuable term in connection with conditions in which a cause is active when no material damage can be proved.

This diagnosis gives the opportunity of enforcing a regimen without unduly alarming the person to whom the term is applied.

However, as it is impossible to say when presclerosis ends and sclerosis begins, and as the term arteriosclerosis has already been extended to cover functional disease of the arteries, presclerosis is not a necessary term. Arteriosclerosis has come in English to stand for a complex condition of the organs of circulation. It conveys a general idea of a hardening of structure, though, as we examine the situation more closely, we find that there is a good deal more to it than a mere distribution of new connective tissue throughout the heart and blood vessels.

An attempt to define arteriosclerosis is difficult, because it must include the various stages in its development and the manifestations in organs affected secondarily by the disease. For these reasons, a mental picture of a clinical disease, built up from what has already been said in previous chapters and upon a reconsideration in this chapter, must take the place of an exact and formal definition.

The causes of arteriosclerosis are chemical and physical. The chemical arise most often as a result of the eating of wrong food, as a result of disease, or the introduction of poisons. The physical causes are strain, due to hyperactivity of nervous origin and over-functional activity to satisfy some physiologic demand. The commonest cause of arteriosclerosis is food poisoning, leading to those conditions that are often characterized by the appearance of indican in the urine.

A typical example from its earliest beginning to a fatal catastrophe, extending over a period of many years without treatment, would be as follows.

A person, thirty-eight years of age, examined on account of some trivial acute condition, is found to have indican in the urine, and a history is obtained of an habitual over-ingestion of a great variety of food and of the lack of exercise. At this time there are no symptoms.

At forty, he has developed neurasthenic symptoms with low blood pressure. There may be a soft blowing murmur over the mitral area, and there may be an occasional trace of albumin in the urine. These indicate the effects of a low grade of slow food poisoning upon the heart muscle and kidneys; at this time the blood pressure still remains low, and the neurasthenic symptoms continue.

At forty-five, if untreated, he commences to show casts as well as albumin in the urine; the blood pressure in rising has reached normal.

At fifty, the man is found with blood pressure slightly elevated and the specific gravity of the urine a little lowered; the heart is somewhat hypertrophied, though probably without murmurs, as the early enfeeblement of the heart muscle has been counterbalanced by the gradually developed hypertrophy.

The urine now contains a trace of albumin quite often, and casts are fairly easy to find.

At fifty-five, if untreated, and subject to the same conditions, over-ingestion of food and lack of exercise, he will be found still suffering from indicanuria and the blood pressure is considerably elevated, to 180 or 190 mm. of mercury. The specific gravity of the urine is one-half what it used to be; the heart is considerably hypertrophied, though even now the man may be free from conscious symptoms. All the points mentioned are those the man is unconscious of,—in fact, he may feel perfectly well.

If the man is free from strain, this condition may continue for a number of years without symptoms, but the damage to the kidneys is greater and demands a higher and higher blood pressure for the elimination that is necessary, and the heart becomes more and more hypertrophied, and the sclerotic processes commence to attack the valves, or some debilitating condition or accidental strain leads to cardiac dilatation.

Now the man commences to suffer from the symptoms of arteriosclerosis, or, as it is popularly known, Bright's disease. There is an unhealthy look, irregularities of cerebral circulation lead to disturbances of consciousness, the arteries often show conspicuous thickening, and there ensues a general failure of nutrition. Under the influence of these conditions the blood pressure may run up to 200, 220 or 240, and he is liable to accidents in three directions: dilatation of the heart, leading to general dropsy; interference with the circulation in the brain by thrombosis or rupture of some vessel, leading to damage to vision or to paralysis on one side of the body; or the kidneys themselves may cease to act, and, the poisonous products of the body being thrown back upon the system, there results a serious or fatal uræmic poisoning.

This picture of the development of arteriosclerosis from the over-ingestion of food and neglect of exercise is found among people who lead perfectly regular lives and consider themselves to be closely adhering to the canons of a virtuous life.

Arteriosclerosis starting in the forties reaches its termination in the sixties; or, starting in the thirties reaches its termination in the fifties.

It is necessary here to speak again of alcohol. Apparently it has but little influence in the production of arteriosclerosis. Its chief evil seems to be that by taking the place of food it causes a relative excess of food products. Men who do not eat to excess often use alcohol over a long period of years without any production of arteriosclerosis whatever; other physical and mental evils, though, may at the same time develop.

The second group in frequency is comprised of those who develop degenerative inflammation of the heart and blood vessels following infectious diseases. Typhoid fever, diphtheria, scarlet fever, syphilis and epidemic influenza are all capable of starting this process. It usually shows first by symptoms referred to the heart muscle and upon the kidneys.

Of metallic poisons, lead is perhaps the most often recognized, but there are probably others some of which find their way into the system in combination with alcohol. This accounts in a measure for the fact that heavy drinking in the upper classes is less fatal than among the lower classes, who consume the poorer qualities of wine and whisky.

Arteriosclerosis, resulting from functional hyperactivity, is conceivable as a result of pure nervous influences in the man who undergoes prolonged mental strain, incident to an exciting business or professional career. This continuous high pressure results in damage to the heart and blood vessels.

Men of a gloomy temperament are much more prone to this form of pressure than the light-hearted.

It is neither fair to the patient nor consistent to truth to make light of the importance of arteriosclerosis; but it can be said that the outcome depends in a great measure upon the patient himself.

(As to the prognosis, there is, of course, a difference between local arteriosclerosis (and the place of the localization) and general arteriosclerosis, and the effect of both (local and general) upon the heart, respiration and circulation.)

Under a suitable hygiene all cases of moderate severity can maintain a good degree of health for a great many years, and progress may practically be suspended. Those who have undergone some accident, such as hemiplegia, dilatation of the heart or uræmia, can under suitable hygiene avoid further trouble for an indefinite period of time.

(We have to make a difference between the senile arteriosclerosis developing itself slowly, and the arteriosclerosis which shows itself in younger people and developing itself fast, caused, usually, by an irrational manner of living, infection, etc.)

Much depends upon the discovery and removal of the original cause.

I have seen a person who has suffered, not only one, but several of the accidents, show continued improvement for the past eight or ten years, and be still capable of doing his work and enjoying a great many things. During the same time I have seen those who, neglectful of suitable care, have suffered accidents with disastrous effect.

Arteriosclerosis, when carelessly considered, is alike discouraging to the sufferer and to the physician,—to the former because so little is evident in the way of observable disease, and to the latter because often enough he cannot command obedience except at such times as some serious complication has arisen.

Diet is of the utmost importance, as are courses of treatment, such as are required to put the patient in a proper condition. A person with this tendency should give up at least two months every year to physical treatment, accompanied by mental relaxation. Upon this in a great measure his future rests.

Much also depends upon the skilful use of drugs to regulate conditions. The human body is like an intricate machine, and has within itself mechanisms for adjusting the forces that tend to its destruction. In arteriosclerosis these forces have gone wrong, and outside help is necessary. Every machine requires a period of overhauling and renovation—a steamship, an automobile or a watch must after a

time be overlooked by a skilful mechanic. This is equally true of the human body when it has shown a tendency to be unable to take care of its own compensations.

A person suffering from arteriosclerosis should be examined by a physician once a month and should undergo a complete course of treatment once a year. In this way the chances of a long and comfortable life are fairly good.

Nature covers up and conceals failures of circulation, and when symptoms appear they are usually of serious import.

The discouragement of physicians in the presence of arteriosclerosis depends upon the difficulty of gaining the consent of the sufferer to follow a sufficiently rigid regimen. This is particularly true in America, where people are not accustomed, as they are abroad, to direction and control.

The worst outlook is, of course, in those who have done badly in spite of adherence to hygienic rules, but even in these an analysis usually shows that there is some particular error of which they have been entirely unconscious.

Heredity is almost always considered in connection with arteriosclerosis, but in the light of our theory of the usual cause of the condition it sinks into comparative unimportance in its pure sense.

People inherit habits of life and diet and are subject to the same surroundings as their family. Primary sensitiveness to particular articles of food does, to be sure, appear in certain families, but this is not commonly so. It is more often found as an isolated phenomenon. Let the individual escape the sensitizing accident or not eat the dangerous protein, and the disease may be avoided.

Some of the oldest people I have ever known had no hereditary right to old age. It is a standard newspaper joke, that the nonagenarian has smoked and drank since childhood. All cannot escape accidental sensitization, but all can watch for the early signs of food poisoning, make a study of diet, and keep out of serious trouble.

The functions of the heart muscle suggest those of the blood vessels. We find that the function of the cells of the median or muscular coat of the blood vessels that is of the

greatest present importance is tonicity, although I venture to believe we will eventually be able to understand the relation between arterial disease and the other functions, such as excitability, conductivity and contractility.

It is certainly true that the muscle cells of the blood vessels are just as capable of acting independently of the nervous system as are those of the heart. So we shall probably have to add the property of stimulus production. At present, however, I have found in clinical work a useful classification of tension in arteriosclerosis may be founded upon tonicity of the median coat.

The diagrams in Plates I. and II. attempt to show my own mental picture of the condition of the blood vessels before and after successful treatment.

The first diagram represents hypertonus with atheroma, showing the effect of hypertonicity and the condition of the artery when this is relieved. Atheroma occurs almost as a certain event in the history of nutrition as life advances. It may exist for years without any effect on the individual, as the diagram suggests, but if hypertonic contraction complicates it serious results follow.

The second represents the condition of the arteries found in neurasthenia, and from depressing diseases which may be of toxic origin, and consists of a relaxation of the median coats of the blood vessels. I have labelled it hypotonus. The diagram shows a section of the normal vessels, a section of the vessel when dilated and a section of the vessel when restored. This condition must be familiar to all clinicians, and represents a temporary loss of tonicity of the blood vessels. In shock of sudden onset I believe this is always primarily present, but that if the heart is profoundly affected it is soon replaced by a compensatory hypertonus that gives the high blood pressure reading that has led to so much confusion.

The third diagram shows a simple hypertonicity of the muscle cells of the median coat, the condition just mentioned as coming from shock. It represents a physiological reflex to create the blood pressure that is required in the body. It

PLATE I.

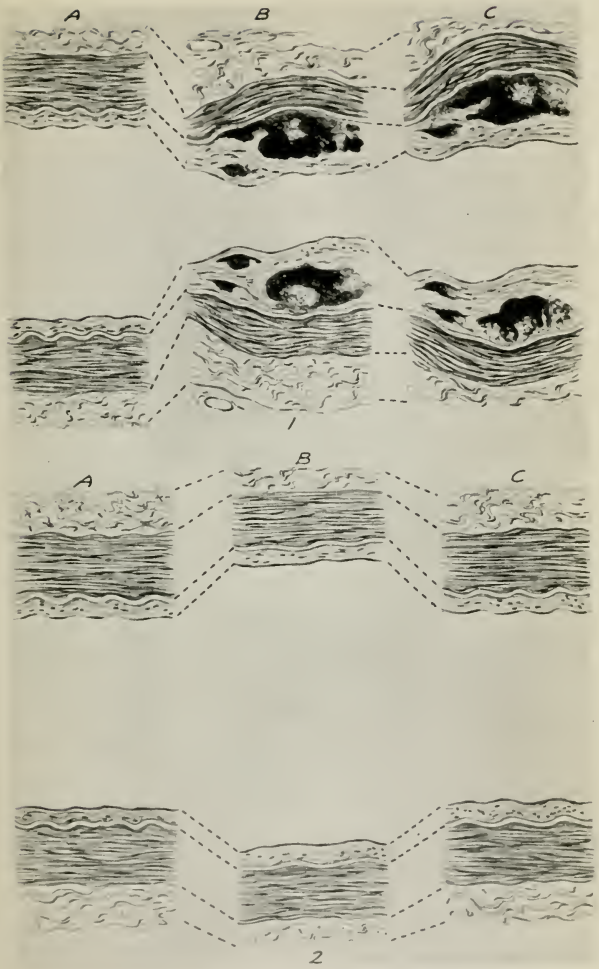

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PLATE II.

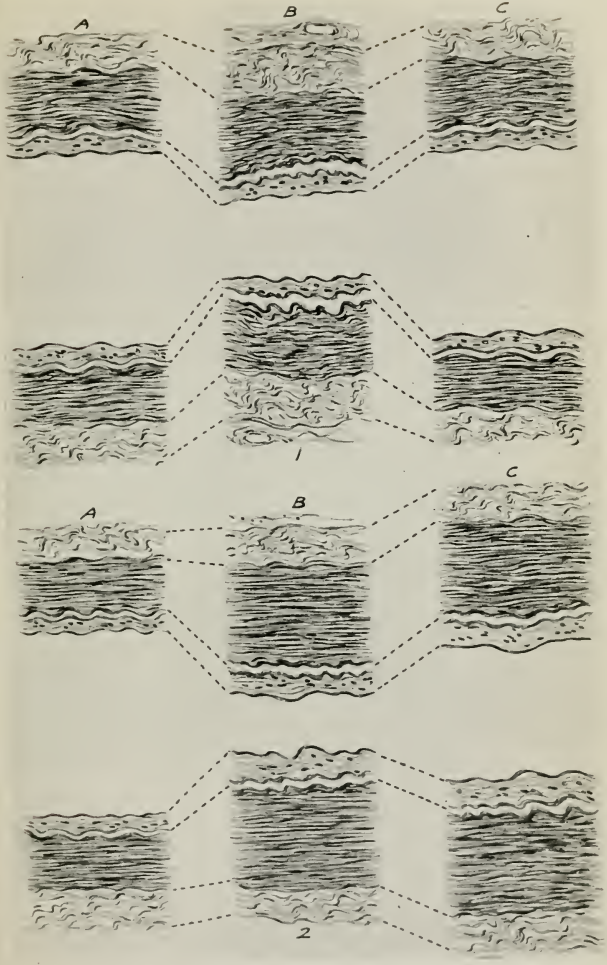

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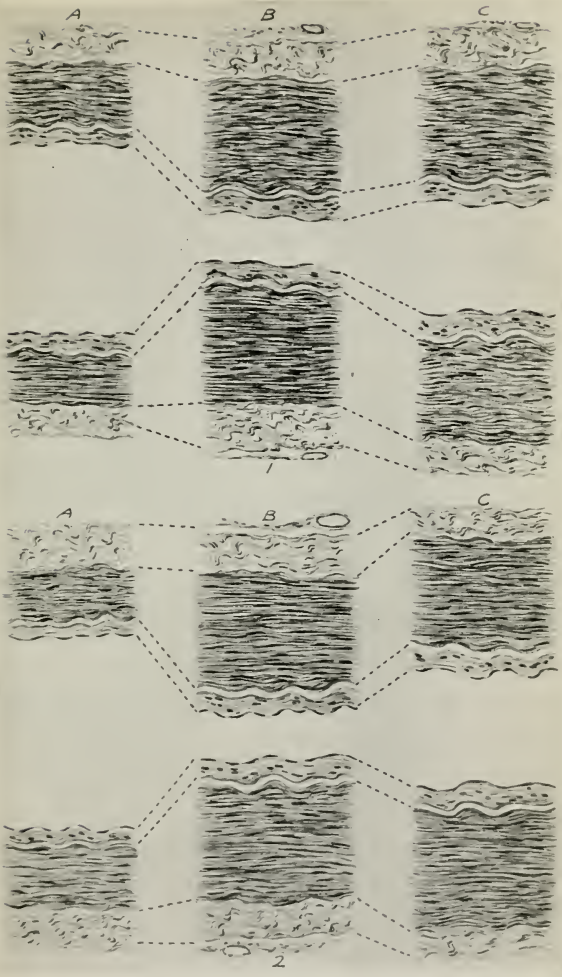
PLATE III.



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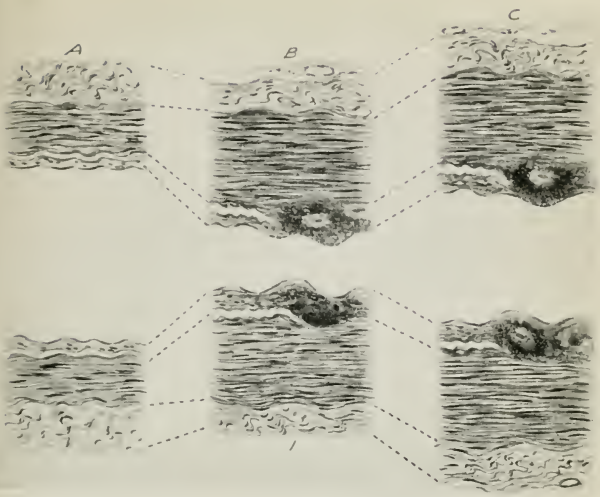

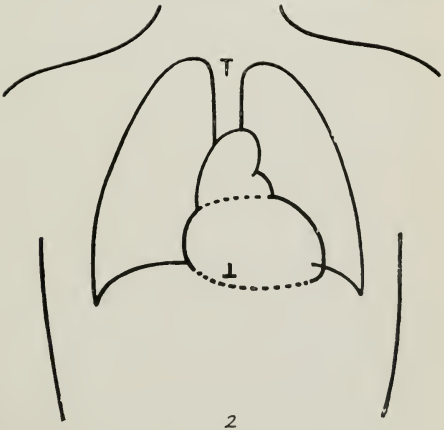

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is also supposed to be caused by direct action of the toxins on the blood vessels. It seems certainly to be caused by conditions of the nervous system. In this class the vessel is healthy in structure though disordered in function.

The fourth diagram represents hypertonicity of the muscle cells of the median coat in simple sclerosis. This is a very important division, because the diagram illustrates the effect of relaxation of the median coat on the calibre of the artery which may result from appropriate treatment.

The fifth diagram shows hypertonus with hypertrophy of the media. This condition is accompanied by hypertrophy of the heart, and is a frequent association of those that have gone on to cardiac dilatation. It is the most serious lesion of the blood vessels, and is ordinarily accompanied by an increase of the connective tissue and other lesions, as is shown in subsequent diagrams.

This sixth diagram shows hypertrophy of the media with sclerosis: (*a*) a normal artery for comparison; (*b*) the artery contracted; (*c*) the artery with its hypertonicity relieved.

The seventh shows the same relative conditions with hypertrophy of the media, sclerosis and atheroma.

It has seemed to me in clinical work that all forms of arterial disorder and degeneration could be divided into groups corresponding to the changes shown in these diagrams, and that in all of them the important element to be considered is the condition of the fundamental functions of the muscle cells, particularly the function of tonicity.

I am sure it is very easy to pick out, among people with poor circulation from nervous and exhausting conditions, plenty who are distinctly suffering from loss of tone of the blood vessels. It is likewise easy in clinical work to detect hypertonicity of the arteries. The small, cord-like, radial pulse, the high blood pressure reading, often under conditions of heart failure, and the toxic appearance, all make hypertonicity easy to diagnose.

The onset of sclerosis in arterial disorder is not always so easy to prove; still, quite early in the disease the hard pulse, the tortuous and visible temple arteries, the thickening

of the artery at the wrist (when it is not contracted and the tension is not high), the symptoms of impaired circulation in the viscera, the præcordial distress and the tendency to albuminuria, make at least a fairly clear picture.

Atheroma is easily detected, in the arteries that can be palpated, by the existence of nodular irregularities; but barring the danger of accident from rupture, this lesion is not so important as sclerosis.

Hypertrophy of the media is the most important lesion in many, and it is to be suspected where there has been long-continued high pressure with hypertrophy of the heart. When it has developed it is often extremely difficult to control the blood pressure. It is to be detected by a thickening of the artery which is more marked than in sclerosis. It is often a nice question to decide how much of a thickened artery is due to fibrous tissue and how much to a contracted, hypertrophied median coat.

While it is not infrequent that these lesions, namely, hypotonicity, hypertonicity (both purely functional), sclerosis (by itself), atheroma (by itself), and hypertrophy (by itself), can be diagnosed, yet more often we have combined disorders and lesions.

Hypertonicity leads to sclerosis and hypertrophy of the media, and as age advances, if some diathesis comes into play, atheroma is apt to be engrafted on the already diseased artery.

Hypertonic contraction in the presence of sclerosis, atheroma and hypertrophy of the media is often difficult of interpretation; but when such an one, through some mischance, suffers a loss of tone in the muscle cells of the blood vessels, then indeed we have a puzzling train of symptoms, for no matter how diseased the artery may be, short of certain freak examples where the arteries are actually calcified, there still remains a possibility of pathologic relaxation.

Atheroma is unaccompanied by all the toxic symptoms that go with arteriosclerosis, and is unaccompanied by shortness of breath or circulatory symptoms.

In arteriosclerosis all sizes of blood vessels are involved,

PLATE V.

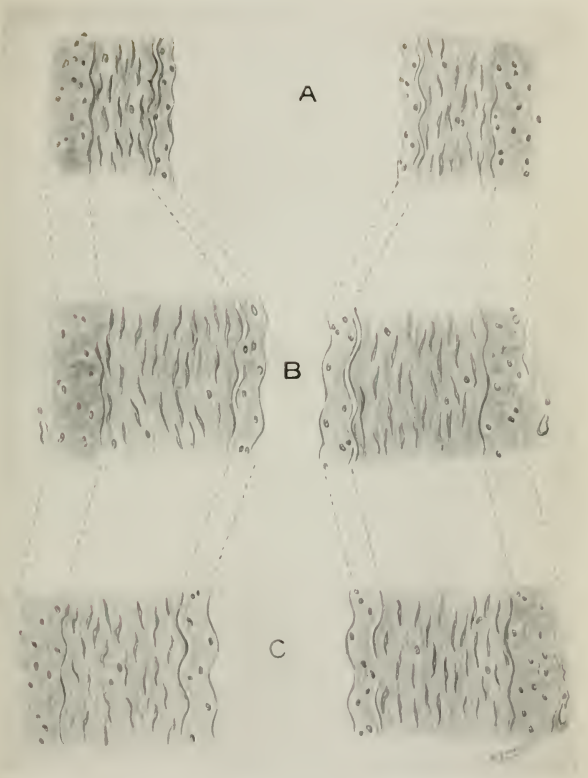

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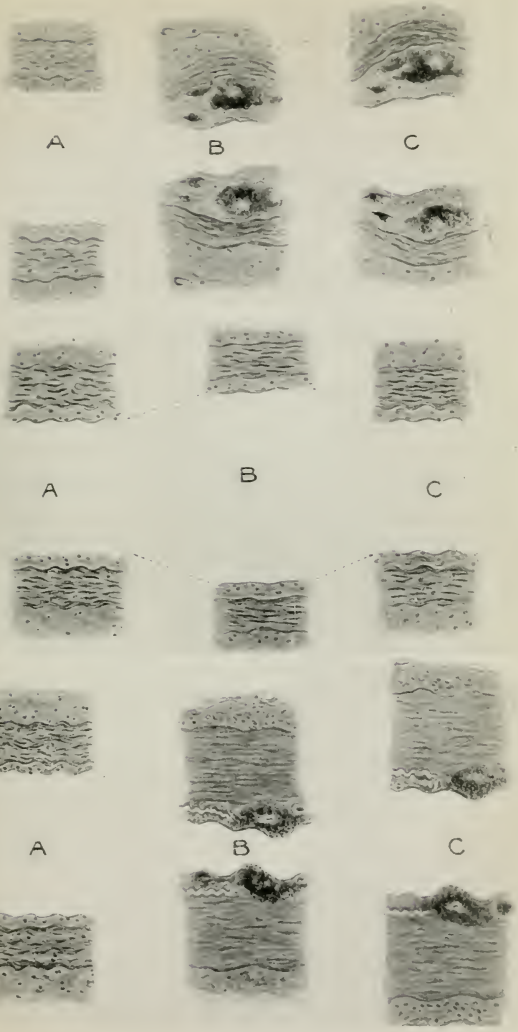
PLATE VI.



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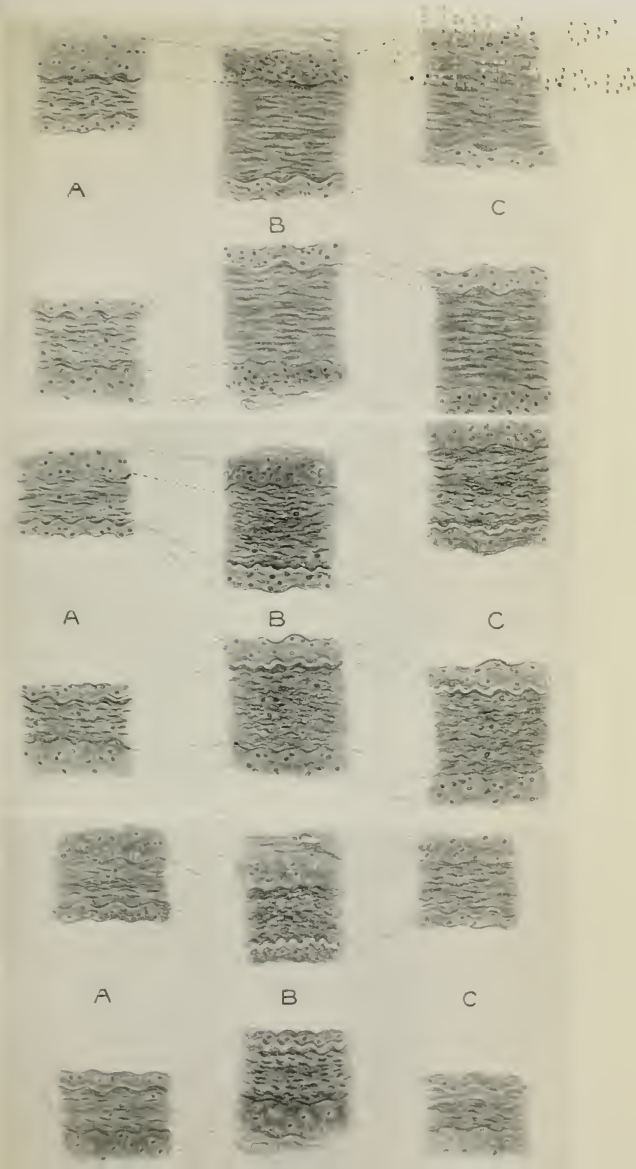
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but the effects of the most importance are in the peripheral and visceral arterioles. At the same time that the arteries are involved, the organs themselves undergo changes from the same influence.

Atheroma remains confined to the blood vessels; arteriosclerosis also involves the viscera.

So it comes about that very striking developments of atheroma are often present without any symptoms at all, whereas arteriosclerosis may be hardly discoverable and yet give rise to serious conditions of shortness of breath, insomnia, high blood pressure, dilatation of the heart and paralysis of the kidneys.

The changes of atheroma are purely changes in the vessels, whereas the changes of arteriosclerosis involve also the vital organs.

I am afraid that even at this late day the mental picture of some who speak of arteriosclerosis is really that of atheroma.

I constantly hear physicians speaking of the exaggerated interest the public is taking in arteriosclerosis, and the evil that has come of calling attention to the matter of blood-pressure. In the light of the extreme importance of the result of the disease, in the light of its foundation in vices of hygiene, and in the light of the neglect of the profession itself to appreciate the importance of food poisoning, whether classified under this precise name or not, I believe that it is fortunate that the public is taking an interest, and that the profession is inclined to study the subject seriously.

V

SYMPTOMS

QUITE a number of physicians have expressed the hope that arteriosclerosis may be put on a more definite basis as to symptomatology.

There are two difficulties. In the first place, there are no symptoms during the early months and years of the disease. In the second place, the process involves cells in all parts of the body and in many different kinds of structures. It is a continuous subsymptomal process which only makes itself known when some function is interfered with. This process is probably in the nature of anaphylaxis from some protein (or bacterium, which is the same thing) to which the cells have become sensitive.

From this it may be inferred that symptoms will depend upon what structures are first involved. It has been the custom to blame disturbances of blood supply, but, in fact, it is only late in the disease that this is true. The symptoms, when they appear early, are due to cellular irritation of the organ giving the symptoms, and may be distributed to several organs. Thus in a young person pathologic fatigue, depression of spirits, numbness of the hands, hypersusceptibility to tobacco may be first noticed. These are found when there is a history of some previous severe illness, or in persons in the thirties or in the forties without any such history.

In retrospect of the first five years of my practice spent in a neurological clinic, I know I was guilty of labelling many such as neurasthenics.

When the disease is well established, very few escape

some degree of præcordial pain on exertion or under the tension of digestion.

If hypertension develops, there may be epistaxis. When the arteries become involved, hypertrophy of the heart follows; and under some circumstances, dilatation. These have their own well-known signs and symptoms.

It must be recognized that the poison groups of protein molecules may be either pressor or depressor in their influence on the blood vessels, and this is recognized in one way or another by a good many observers.

Huchard, in his definition of Arteriosclerosis (which is a very good one, and is quoted elsewhere), says, "clinically it is manifested by toxic symptoms giving rise to vascular spasm and variations of arterial tension."

When the median coat of the blood vessels is attacked by poisons, relaxation may result. This happens almost uniformly when, from such a cause, neurasthenic symptoms develop in a person. Later on, if unadvised, he will show the cardiorenal type of high blood pressure. This process is so gradual that one observer would not be able in his life to follow many examples through all the stages, but it is comparatively easy to recognize different persons in the various stages and draw a composite picture covering the whole period of the disease.

Mr. D., referred to me by Professor W. K. Simpson, of the College of Physicians and Surgeons, was a typical example of the neurasthenic stage verging upon the cardiorenal type. He was forty-two years of age. His father died at sixty-nine, and his mother was living at seventy-nine; he had four brothers living and well. He was five feet eight and three-quarters inches tall, weighed 175 pounds, and had been gaining a little. He was blonde, brown eyes, very neurotic; says he slept poorly, had a good appetite, but eructation of gas followed his meals. His bowels were constipated, and he was constantly taking laxatives. He used tobacco, coffee and tea in moderation; no alcohol. He had had no severe illness, but had been suffering from various symptoms for eight years.

On examination his pulse was found to be 84. The heart was slightly hypertrophied, and there was a faint systolic murmur over the mitral area. He complained of a sense of compression over the mid-sternal region.

On account of the sternal pain he had been told that his heart was weak, and was in fear of death from heart disease. He was subject to migraine with attacks recurring about every two months. His manner was typically neurasthenic, and he gave a long history of various indefinite complaints which made this diagnosis almost certain.

The præcordial pain, elevation of blood pressure, the persistent presence of indican in the urine, the slight thickening of the radial artery, and the existence of a slight

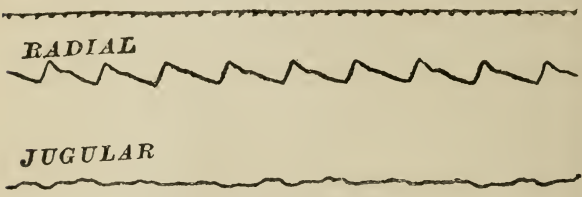

Fig. 2.—Polygraph tracing—Mr. D.

murmur made it fair to suppose that he was in the early stages of arteriosclerosis.

On a proper regimen he improved a good deal as to his objective signs, though the neurasthenic symptoms persisted in a measure. (Fig. 2 shows normal tracing after treatment.)

Just as a precise definition of arteriosclerosis has given us trouble, so it is difficult to give a precise symptomatology.

The experienced clinician has no difficulty in deciding the matter. If there is anything absolutely characteristic of arteriosclerosis, it is the total absence of disagreeable feelings in the early stages of the trouble. Indeed, even the development of high blood pressure often causes a sense of exhilaration and capability that is very misleading to the man himself and his friends. No one wants to be an

alarmist, but a man in active affairs is in danger when he gradually loses the fatigue sense, so that his capacity for work seems to be increased at middle life when it ought to be the same or less than in youth; when the colour becomes higher and the capacity is lost for relaxation (light literature, vacations, society, and sane amusements). This condition would deceive any observer without the help of a sphygmomanometer and the chemical laboratory.

A review of the clinical cause of arteriosclerosis shows that insomnia is a troublesome incident of all stages. Early in the development of the trouble it is perhaps most significant; while, when the condition has reached its greatest development, it becomes one of the most difficult factors that we have to deal with.

The early insomnia of arteriosclerosis has certain peculiarities all its own. The victim goes to sleep well enough, but toward morning—two, three, four, five o'clock, the sleep ceases and the mind becomes active, particularly with regard to matters that have been occupying the attention during the daytime. This activity does not necessarily take the form of worry, but the wheels of the mind seem to grind, as it were. After an hour or two this passes off, and the victim sleeps soundly, about the time he ought to get up.

When a person past forty suffers in this way there should be an examination with a view to determining the presence of auto-intoxication, alterations in blood pressure, and thickening of the arteries; and unless some other cause is discovered, a regimen opposed to arteriosclerosis should be instituted.

At this stage the condition promptly yields to measures directed at the food poisoning.

The insomnia of fully developed arteriosclerosis is much more difficult to deal with. This has, in all probability, a chemical cause, and frequently does not give trouble if the chemical activities of the body are reduced to a minimum by the withholding of heavy food at the latter part of the day.

While high blood pressure is extremely common, the time is past when arteriosclerosis and high arterial tension are to be considered as necessarily associated together. Indeed, one does not have to go very far in the experience of the worker in this field of medicine without finding persons with unmistakable evidences of the disease, without increased or even with diminished blood pressure.

I saw a man recently in whom there had been a coincident development of arteriosclerosis and chronic neurasthenia. In this man, forty-one years of age, the blood pressure was 110, while the sclerotic changes in his circulatory system were such as, in a man without neurasthenia, would undoubtedly have given a high blood pressure.

This is not at all an uncommon combination of disease, and it would seem that the relaxing influence of that profound disturbance of the nervous system had diminished the tone of the median coat of the vessels. Neurasthenia has among its many definitions one which specifies it as pathologic fatigue. This definition has always appealed to me as containing a good deal of truth.

Furthermore, my own observation is that the best possible treatment of high arterial tension in those who have developed arteriosclerosis through nervous and chemical causes, is the physiologic fatiguing of the muscles through enforced exercise. Thus the significance of low blood pressure in this group would seem to be, that there is some influence acting upon the median coat of the blood vessels resembling in its physiologic effect that which can be obtained in a measure by voluntarily acquired fatigue.

Another group showing relatively low blood pressure in arteriosclerosis is found in certain individuals in whom the causes of trouble have been eliminated. This is found in men who have overworked and worried, and perhaps overeaten and abused alcohol, who later have adopted a proper hygiene and have recovered from their high tension, though the sclerosis remains. High arterial tension is always the result of a physiologic demand, and when this

physiologic demand ceases to exist the tension may recede, though the damage to the vessels may remain. Of course, this cannot be true in extreme instances. In both the persons spoken of it is in a measure advantageous that the high tension does not exist.

There is a third kind of low blood pressure that has a more sinister significance, and that is the secondary low blood pressure that comes in arteriosclerosis when the heart becoming insufficient, and the demand for high pressure continuing to exist, the circulatory organs are no longer able to maintain the tension.

One of the most elementary lessons that is taught by experience is that many times high blood pressure is a conservative process, and means that nature is maintaining the integrity of the circulation in spite of obstacles. A person who has carried a blood pressure of 240 and who has areas of the brain, and probably of other organs, in which blood vessels have been damaged, would fare very badly with a blood pressure of 140, while such a person reduced to 170 to 200 and kept there, principally by hygienic means, is capable of maintaining health and happiness for an almost indefinite time. But let some untoward circumstances, such as dilatation of the heart, or general enfeeblement of the body, or a profound nervous shock, or some severe illness cause a relatively low blood pressure, and the outlook immediately becomes very grave.

(In cases of local arteriosclerosis, as for instance in the thoracic aorta or the radial artery, the blood pressure is not increased; also in cases of sclerosis of the coronary arteries, if not combined with general arteriosclerosis.)

In this study we recognize two great groups of low blood pressure in arteriosclerosis. In the first group the tendency toward high blood pressure has been neutralized by relaxing nervous influences, while the circulatory organs were not sufficiently damaged to make high pressure necessary for good circulation; or the cause of sclerosis (which cause also demanded high blood pressure) being removed, the

sclerosis itself was not sufficient to demand a high blood pressure. The other group is that in which low blood pressure exists in spite of the necessity for high blood pressure, with unfortunate results.

(If we find high blood pressure we always have to suppose that there are sclerotic changes at the splanchnic arteries. In cases of *very* high blood pressure we always have to consider if there are not changes in the kidneys, even when the urine gives no such signs.)

The development of anasarca in arteriosclerosis always means the establishment of some complicating condition,—either on the one hand a dilatation of the heart, or on the other hand a functional paralysis of the kidneys. Without these complications there is no dropsy in the course of arteriosclerosis.

(Electrocardiography shows, as is stated in the book of Kraus and Nicolai, sometimes a high initial elevation, as a sign of hypertrophy of the left ventricle; often there is a low final elevation, which sometimes disappears completely, whereas, again in other cases, the auricular elevation is very low. Dr. Theo. Groedel, who is practising electrocardiography in Nauheim, cannot find as yet any form of the electrocardiographic tracings characteristic of local or general arteriosclerosis. The alterations just named are also to be found in cases where there is not any symptom of sclerosis of the arteries.)

How far are we justified in drawing the conclusion that one part of the arterial system is sound because we have examined another? That the arteries of the brain are sound because we have found the radial artery normal? In the greatest number of persons suffering from arteriosclerosis the disease is general, but in a few instances marked disease of the celia axis, basilar or coronary system has been discovered.

The vital function of the coronary arteries makes their condition of sclerosis secondary in importance to none, not even that of the brain.

Their sudden plugging by thrombosis is not so difficult

to recognize as might be supposed. The pain and dyspnœa are characteristic, and the accompanying heart failure is unlike the usual phenomenon of a typical attack of angina, when the pulse is surprisingly good, the breathing often not much disturbed, and the pain tends to improve and disappear. Like many attacks of angina, there is often nausea and vomiting and tympanitis. The non-response to cardiac remedies is very characteristic. In ordinary angina there is usually a tenderness of the skin which may be quite persistent, but in plugging of the coronary arteries the pain itself is continuous and increasing.

The question may arise, how to distinguish heart disease of rheumatic origin from heart conditions that come in the course of arteriosclerosis. To the least experienced the difference in the types is very marked. The pure heart condition leads to venous stasis and a stagnation of blood in the organs, and the heart tends to become exhausted because of its own inherent defects.

The heart conditions of arteriosclerosis are different. Here the spasm of the arteries leads to a deficient blood supply, and the dangers from angina pectoris, apoplexy and failure of the kidney are manifold.

In the first set of conditions, the heart is primarily involved; in the second, the blood vessels are first affected and later the heart.

Many of the best writers on the heart (and much of the best literature in medicine has been evoked by this subject) have drawn a clear distinction between mitral and aortic cases. Without confirming my statement by actual review my recollection is that an analysis of Balfour, Broadbent, Stokes, Flint, Poynton, Brunton, Russell, Groedel, Mackenzie and others, will show that each has had the feeling that aortic disease belonged to the great group of degenerative examples of cardiovascular disease, while mitral disease belonged to the great group of functional and infectious diseases.

When, in arteriosclerosis, disorder of the mitral valve becomes an important factor in the mechanics of the heart,

the situation has become eventually a cardiac one instead of an arterial, so extensive discussion is out of place just here.

Most people come with the story that they have been examined and that their uranalysis is "all right." As a matter of fact, very few people past middle life can be said to have kidneys that are all right, yet, fortunately, very few kidneys are all wrong. Uranalysis solely for the detection of kidney disease is a very crude conception, and should have been banished from internal medicine a decade ago. We all know of the almost universal presence of casts in small number, and of a faint trace of albumin under conditions of strain or dietary errors; that the excretion of nitrogen is more dependent upon the intake than any other cause, and that the nitrogen retained in the body from food is very small in amount and also obscure as to destination and function.

There is a great future for bio-chemistry, and analysis of the urine will play no small part therein. Undue emphasis has been laid in the past upon microscopical findings, and not enough work has been done on the chemical end. A single examination gives a flashlight picture which, while of extreme value, cannot be compared with the moving picture of repeated and continuous examination. The chemistry of the blood serum and that of the urine have a close relationship which, when understood, will help immensely in the study of dietetics.

We have long since outgrown the conception of Bright's disease as a condition localized in the kidneys, and the liver is beginning to be understood as the possible culprit in the various diseases for which the kidneys have so long been blamed. If some of the research money that is so lavishly spent on bacteriology and infectious disease can be turned to the elucidation of problems of bio-chemistry—problems that are so obscure that their very existence is hardly known—much could be done. The cry, "Save the babies," appeals to the people, but the cry will be heard by and by, "Save the man between sixty and seventy." Saving young people is a problem of infection and bacteriology; saving

older and useful workers in the world is a problem of bio-chemistry. Many good men die in the late fifties and early sixties because of the unrecognized chemical errors of the body. When the significance of chemical examination of the urine is appreciated and applied to apparently healthy individuals in time as much will be accomplished in saving life during the last natural decade of life as has been done during the first decade.

There is no way of arriving at a correct estimate of the condition of the machinery of the circulation except by a complete examination. Things that seem most plain are often completely misinterpreted. In the gentleman of whom an account is given in the account of fibrillation, my first judgment was altogether erroneous. I said to my neighbour, the physician who brought him to me, "He seems like a person with very poor kidneys," but the Mackenzie polygraph showed that the auricles and not the kidneys were at fault and he responded promptly to treatment.

Fifteen years ago I supposed a certain gentleman had a serious kidney lesion because the chemical examination showed all the characteristics of such disease. I dined with this man on his seventieth birthday some time ago, and he is still living and the picture of health.

Not only is a careful examination but prolonged observation necessary to a correct opinion which is the only sure foundation of sound advice.

The consultant must ever guard himself against the tendency to the habit of the bad prognosis, that is so safe for his reputation but can do so much harm to the person most concerned, the sick one. If an examination does not reveal some way out of a difficulty, a more careful one may, and observation may bring inspiration.

This is the justification of specialism which has more than once done the impossible in medicine.

When I was a resident in the hospital an operation on the prostate meant death, now it daily brings comfort to old age. At the same time, arteriosclerosis and atheroma were considered the same disease and no one thought of question-

ing that they were necessarily progressive. When cardio-vascular disease becomes a recognized specialty for trained clinicians as well as for laboratory men, we can look for that definite knowledge that will inspire the faith necessary for the enforcement of the rules of hygiene that will prevent as well as check this premature bodily failure.

With regard to mental symptoms in arteriosclerosis, my experience coincides with that of Dr. Thomas J. Currie, of Willard, N.Y., as described in a recent paper.[1]

"Fortunately, not all who have developed arterial changes show serious mental difficulties. Most, however, are subject to a greater or less degree to headaches, vertigo, sensations of fatigue, both mental and physical, various neuralgias, sometimes attacks of migraine; some have subjective impressions of loss of memory, but close examination may not reveal any very serious memory defect. Sometimes a definite memory defect, particularly for figures and names, may be demonstrated. The subjective sense of difficulty in recalling past events is very often present; insomnia and restlessness at night are apt to be troublesome features. When the diseased conditions become more severe there is apt to be greater complaint of headaches, of giddiness and attacks of vertigo in various positions; failing memory, periods of transitory confusion and a state of physical and mental exhaustion will be more prominently complained of. There are apt to be very pronounced alternations in mood, —the patients are often irritable, obstinate and abusive; frequently they exhibit a tendency to weep or laugh with little provocation. Restlessness, inability to sleep and unnecessary activity are often noted; depression, apathy and a tendency to become indifferent are frequently observed. Exhilarated moods are of comparatively rare occurrence. Transitory aphasia or hemiplegia may be explained on the basis of transient ischæmia. Epileptic seizures and the Stokes-Adams syndrome — tachycardio, pseudo-epileptic

[1] "Arteriosclerosis as a Factor in Mental Diseases," read before Seventh District Branch of the Medical Society of the State of New York, at Geneva 15th September 1910.

seizures and Cheyne-Stokes respiration—have been observed in cases where autopsy revealed definite changes in the cerebral arteries. Delusional states and hallucinations occur frequently with excited or agitated conditions.

"The comparatively mild mental disturbances due to cerebral arteriosclerosis are rarely seen in hospitals for the insane. In most of those admitted, the arterial changes are considerably advanced; consequently, there will be little difficulty in locating the cause of the trouble."

In the melancholia group, a considerable number of the early cases show slight or moderate changes in the arteries. In the latter, or the more severe examples, a larger percentage reveal arteriosclerosis. The more severe often show what is called the anxiety psychosis, which appears to depend so much upon the arterial changes. Anxiety, restlessness, fear, exceedingly severe despondency, pronounced insomnia and somatic delusions are prominent symptoms.

"An examination of the statistics of admission in three hospitals in this State for one year gives the following results. In cases of involution melancholia, arteriosclerosis was assigned as a prominent etiological factor in 20 per cent. of the instances (25 per cent. in men and 15 per cent. in women). In the examples of senile insanity reported during the corresponding period, arteriosclerosis was given as one of the definite etiological factors in 36 per cent. of the cases (40 per cent. in men and 32 per cent. in women). The proportion of both involution and senile showing actual degenerative changes in the arteries is evidently considerably larger. An examination of the records of a considerable number admitted during the past eight years indicates that about 40 per cent. of involution melancholia and 70 per cent. of the senile conditions had definite evidences of general arteriosclerosis. Those who show marked symptoms of cerebral arteriosclerosis, without corresponding changes in the radials, temporals or other accessible arteries, probably have developed more advanced arteriosclerosis in the cerebral vessels. Autopsies and the subsequent neurological examinations have shown arteriosclerosis and degenerative changes

in the cortex and the deeper structures of the brain in a large proportion of the involution psychosis and in the greater number of the senile psychoses.

"For mild conditions, a quiet, regulated life in the open air of the country, with appropriate diet, exercise and attention to bodily functions, will prove beneficial."

Dr. Currie describes an example of severe mental trouble which is similar to one that was under my care some years ago :—

"A. E. C.—female, aged fifty-seven years. Paternal grandmother was insane, and starved because she could not be induced to swallow, on account of delusions of poison. Several members of the family died of cerebral apoplexy. The patient developed melancholia shortly after the climacteric when about fifty years old, while nursing relatives, but she recovered. The present attack developed at fifty-five, following physical exhaustion due to nursing husband and other invalids in the family. Marked depression, emotional distress, agitation, incipient delusions of suspicion, somatic ideas. Aural hallucinations, accusing her of wickedness, urging her to suicide, visual illusions of change in the features and forms of people about her, marked restless insomnia. Physically—severe vertigo, headaches and clavus, persistent cutaneous paræsthesias, nephritis and moderately advanced arterial sclerosis. Very fair insight, but her attitude was one of despair. Had vivid aural hallucinations which originated in frontal region of brain, and she was taunted by them. 'They threaten to drive me to desperation; they taunt me to tear myself to pieces. They are so distinct and tormenting, I am afraid I cannot resist the temptation to do something desperate.' Began to improve about three months after admission, and subsequently recovered."

The unbalanced distribution of blood in advanced arteriosclerosis is often a very striking factor, and, as is often said of shock, "the man has bled into his own veins."

In arteriosclerosis we find the small arteries and capillaries of the muscles and skin contracted and almost empty, while the blood has accumulated in the abdominal organs and the

liver. Under the circumstances it is easy to see how the active chemical processes of the abdomen are interfered with, and the general condition known as auto-intoxication encouraged.

It is a mistake to suppose that the resulting poisoning involves only the heart and blood vessels. The lungs frequently enough take part in the process, and not a few people who complain of asthma really belong to the arterio-sclerotic group.

While abdominal pressures and stagnation lead to stupidity during the day, there results insomnia at night; and not a few who suffer with insomnia are simply subjects of auto-intoxication. Peaceful sleep follows de-toxication and the few-protein diet.

Of late years our attention has been so much directed to the disorders of the heart that we are liable to forget that there is such a thing as simple hyposystole. I see this quite frequently in neglected arteriosclerosis due to the depressing influence of the toxæmia. The heart sounds are just feeble. Listening to them gives no satisfactory information of the heart. After treatment the sounds can be heard, and often enough murmurs appear that were absent on account of feebleness. This is particularly true of the onward murmur that is so characteristic of arteriosclerosis.

Sometimes we see persons who, while they have arterio-sclerosis, are really uncomfortable from the abuse of iodide preparations. A very interesting example of this was Mrs. P., who became my lifelong friend when I relieved her of the miseries of iodism, to which she proved to be suscept-ible to a high degree.

It is foolish to commit yourself to rules of treatment, for the very next moment some circumstance may arise that will lead you to act entirely contrary to your own rules,—medicine being an art, not a science.

However, up to the present time I have never seen a person with arteriosclerosis to whom I have felt it desirable to give large doses of iodides. I find that iodine is much more of a systemic stimulant than is supposed, and, properly

given, there should be attained a traceable sense of well-being.

When seeing people for the first time when they are very sick, the possibility that the symptoms of iodism may be superadded to those of the disease is worth remembering. The value of large doses in aneurysm I have frequently demonstrated.

VI

BLOOD PRESSURE

The term blood pressure is often used interchangeably with arteriosclerosis. This is not as it should be.

High blood pressure, however, is so constant a symptom of arteriosclerosis that low blood pressure in this condition may be regarded as an exception that always demands explanation.

The term blood pressure is often used where high blood pressure is meant. With light thrown on the meaning by the context, this does not lead to confusion, though, of course, during life there is always pressure of blood in the vessels.

To deny a knowledge of blood pressure to clinicians of former times is to have not read the older books. In fact, all careful clinicians for generations have made careful studies of pulse tension. Before the introduction of instruments used exclusively for the study of blood pressure, a number of men were devoted to the use of the sphygmograph. To illustrate this, take Case No. 6 in Angus MacDonald's admirable book on "The Bearings of Chronic Disease of the Heart upon Pregnancy, Parturition and Childbed," London, 1878:—

"Case VI.—Mitral obstruction, with slight insufficiency. Patient ill for two years with recurrent attacks of palpitation and pain in the chest. Sufferings aggravated during the sixth month of seventh pregnancy. Delivery easy. Recovery. (Reported by Dr. Weir, my dispensary pupil.)

"Mrs. Moodie, aged twenty-six, had had six children and two miscarriages. All her children are dead, four of them from jaundice. The patient enjoyed tolerably good health until two years ago, when she began to suffer from occasional attacks of palpitation with pain in the chest, giddiness,

breathlessness and a sense of suffocation. These attacks are wont to come on suddenly with a feeling of languor, last for one, two or three days, and then go off as suddenly as they appeared. She also suffers from a distressing dry cough. So far as she knows, the patient never had rheumatic fever. In October 1877 the patient was for some time under treatment in the Edinburgh Royal Infirmary, under the care of Dr. Muirhead. She got better after a short residence, but, becoming worse, returned again in the end of November. On the 27th of November she was transferred to Ward XVI., under the care of Dr. MacDonald, where she remained a week. The following is the condition of her circulatory system at that date:—

"No regurgitation in the veins of the neck; distinct pulsation in the epigastric region, also in the præcordial region. Apex beat diffused and intensified. Præcordial thrill very evident; auricular thrill only very indistinctly perceptible. Transverse dulness from mid-sternum, 3¼ to 3½ inches; perpendicular dulness normal.

"At mitral area a rough, prolonged murmur precedes and runs up the first sound. The latter is somewhat intensified, but not entirely clear. The second sound at this space is only indistinctly audible and follows very closely upon the first sound. At the tricuspid area the presystolic sound is only feebly audible, but the second sound is well heard and is accentuated; the first sound is less distinct. At the pulmonary area the first sound is somewhat impure, the second accentuated and frequently reduplicated. At the aortic area the first sound appears pure, the second sound is accentuated and often reduplicated.

"At the auricular area the presystolic murmur is audible, but not so loudly as at the mitral area. The patient has also a very troublesome cough, but examination of the lungs reveals nothing abnormal. At this period the patient believed herself to be in the seventh month of pregnancy. The fœtal heart's beat could be distinctly heard. The patient is pale and somewhat anæmic, and is also of a highly nervous disposition. The treatment adopted was digitaline granules,

dialysed iron, rest and care, with a dose of bromide of potassium at night.

"It is to be noted that in the record of her case taken in October the second sound in the aortic area was observed to be feeble, and the transverse dulness towards the right very slightly increased.

"She left the Infirmary in the beginning of December, after which the cough and dyspnœa got rather worse. The sputum was noticed to be streaked with blood on the 15th of December. On the 7th of January 1878 she felt very poorly, in consequence of some extra exertion. She complained of recurrent attacks of syncope, and there were moist sounds heard over the base of the right lung. There were some pains in the abdomen and back, but no evidence of the commencement of true labour pains.

"On 31st of January she sent for me at 4.30 p.m., believing herself in labour. The cervical cavity was found to be obliterated, but there were scarcely any labour pains. The patient was suffering from dyspnœa, giddiness, headache and pain in the cardiac region. Dr. MacDonald and Dr. Playfair saw her at 11 p.m., and the following note of her condition was made:—

"'Slight venous pulsation in the neck. Præcordial thrill well marked, vertical dulness natural, transverse four inches.

"'At the mitral area a soft systolic murmur is audible, but very little of the presystolic murmur can be heard. In the tricuspid area the first sound is impure, at the base the pulmonary second sound is accentuated, and so is the aortic second sound. The pulse is 96.'

"The patient was ordered a belladonna plaster to be applied over the region of the heart, ten minims of tincture of digitalis every six hours, and also a mixture of aromatic spirits of ammonia and of spirits of chloroform as a stimulant.

"At 4 a.m., 1st February, Mrs. M. was delivered of a healthy female child. The labour was very easy and rapid, and was finished before I arrived. The placenta was expelled by the natural contractions immediately afterwards. The

patient felt greatly relieved after delivery, and made upon the whole a good recovery.

"The patient's case is clearly one of mitral stenosis, but not of great severity. A considerable number of the disagreeable feelings experienced by her must be explained by reference to her highly nervous temperament. Still, notwithstanding these facts, one notices the evil effects of the pregnancy in disturbing the cardiac equilibrium, and we are

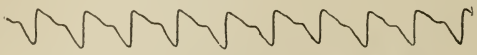

Fig. 3.—High tension pulse—case of Mrs. M., 1877.

able to watch with tolerable precision the march of its influence by following the history of her physical condition. In October the ward book gives the transverse dulness at the base as very slightly increased to the right; by the end of November it had travelled quite to mid-sternum, and measured $3\frac{1}{4}$ to $3\frac{1}{2}$ inches, whilst at the confinement it had made a farther increase to the right so as to give a transverse dulness of 4 inches. It is also observed that there was at the confinement visible venous pulsation in the neck. Changes indicative of greater tension were coincidently observed in the

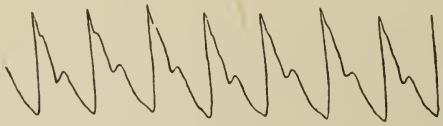

Fig. 4.—Pulse tracing, Mrs. M., after delivery.

systemic circulation, for in October the aortic second sound was noted as feeble; in the end of November it had become markedly accentuated, so that the vascular tension had been gradually increasing both in the lesser and in the greater circulation. Co-ordinately symptoms of difficulty of breathing, palpitation and cough, and of pulmonary œdema, became more and more manifest. Evidence of high tension, on the evening

when the labour commenced, is seen in the accompanying tracing, Fig. 3.

"We tried several working pressures, but obtained the best results with one of 7 ounces. It required the exertion of a strain of 18 ounces on the spring of the sphygmograph to entirely obliterate the radial pulsations. Independently of these considerations, the tracing itself exhibits characters indicative of considerable tension. The up-stroke is quite perpendicular; the tidal or predicrotic wave, though clearly not so well pronounced as it would have been had the pulse not been so quick (the rate is stated in the report to be 96), is nevertheless in several of the parts of the tracing well developed. The special prominence of the dicrotic wave is most probably to be chiefly accounted for by the rapidity of the pulsations.

"The tracing, Fig. 4, obtained the day after her delivery, presents some peculiar characteristics, and therefore I have included it also. The best working pressure in this instance was found to be 5 ounces, and the obliterating pressure 15 ounces. It will be noticed that the up-stroke is of astonishing length. In this respect the tracing bears considerable likeness to those which we obtained in making some experiments on the effect of the Turkish bath upon pulse tension. Undoubtedly the Turkish bath must quickly and effectively diminish the resistance to capillary circulation, very especially in the skin, but also throughout the body. At the same time, the application of heat must act as a stimulant to the heart. In this patient's case we have the presence of a high up-stroke with still considerable cardiac force, seeing that the best tracing was obtained by a pressure of 5 ounces, and the obliterating pressure was as high as 15 ounces. It would thus appear that the delivery had in some way brought about very decided diminution in the capillary resistance, without at the same time very markedly weakening the force of the cardiac muscle. This coincidence of character in Mrs. M.'s sphygmographic tracing with that of the tracing of a healthy pulse in a Turkish bath is extremely interesting, and seems to me to lend important

support to the opinion expressed by Dr. Mahomed, that the height of the percussion wave in a sphygmographic tracing is very largely conditioned by the amount of resistance offered by the capillary circulation to the action of the heart.

"In comparing such a tracing with that obtained in the Turkish bath, it is always to be remembered that there is introduced a disturbing element, whose effect it is difficult to estimate,—I mean the loss of elasticity sustained by the spring of the instrument, as a result of the high temperature at which it is working. That element would, of course, act in the direction of exaggerating the length of the up-stroke. We did not attempt to estimate the pulse tension in the bath, because the results would have been worthless and would only have introduced a fresh source of fallacy. Besides, it was next to impossible to work with the metallic parts of the sphygmograph in the great heat of the bath.

"But what was the cause of the diminished capillary resistance in the present instance? It seems to me to have probably been partly due to nervous causes, for the patient's nervous system was specially peculiar, but essentially referable to the changes in the circulation which were brought about by the delivery. It bears out, but in an exaggerated degree, the opinion that we arrived at as a result of the facts considered and compared in Chapter II., namely, that delivery does diminish to a certain amount the general arterial tension, without, however, reducing the action of the heart to the normal standard. I do not quite see why the presystolic murmur should have disappeared in this patient's case during the labour, as, though it occasionally vanished during the pregnancy, it was tolerably steadily present. It is well known, however, that this murmur is apt to come and go. Its disappearance could not be due to a loss of cardiac force, for the pulse tension was good. It seems rather to have been due to some change in the nervous supply to the heart. Its disappearance, along with the persistence of good force in the pulse, would seem to support the view that there was only a limited degree of stenosis in this patient's mitral.

"Again, the presence of the systolic murmur during the

delivery could hardly be considered entirely due in Mrs. M.'s case to dilatation of the right ventricle, and consequent tricuspid insufficiency; for the murmur was very imperfectly heard over the tricuspid area, and much better over the mitral. The first sound, throughout the period during which the patient was under observation, was never quite pure. As, however, we have evidence of rather acute dilatation of the right side of the heart, it is possible that a certain amount of this soft systolic murmur may have originated at the tricuspid orifice.

"Though the labour was got over without much discomfort, the symptoms from which the patient was suffering on the night previously clearly demonstrate that had there been any unusual, even had there been the usual, difficulty during the second stage, the consequences might have been serious.

"I think, also, some of the immunity from danger which fell to the lot of this patient was due to the careful measures taken to avoid all possible sources of danger to the patients. These measures were observed because we had, before they came to be requiring treatment, greatly improved our knowledge of the possible risks they ran, as well as of the necessary precautions to be observed in their management.

"These good results encourage us to believe that judicious and skilful management of similar cases, both throughout the pregnancy and at delivery, might greatly lessen the risks associated with lesions of this nature."

This case is evidently one of those which we frequently observe of secondary changes in the peripheral arteries in chronic heart disease. It is quoted as an example of the study of blood pressure in the days before the sphygmomanometer came into use. Many of the facts in such cases have now been explained. It also shows how old is the difficulty in interpreting the appearance and disappearance of presystolic murmurs, upon which we have only of late been enlightened by the work of James MacKenzie.

While it is now generally acknowledged that the quantitative estimation of intra-arterial pressure cannot be determined by the tactile sense, good clinicians have always been able to

draw conclusions of great clinical importance. Instruments for the measurement of blood pressure have become of so great importance that a separate chapter is given to them, leaving this chapter for the theoretical discussion of the clinical bearings.

It must be evident to the most superficial observer that persons suffering from variations of blood pressure can be divided into classes. As to the naming of these classes and the exact distribution of examples of this trouble, there may be some difference of opinion.

For the last ten years or more the following classification of these symptoms has been found to correspond with the experience of a practice devoted exclusively to work among persons liable to disturbance of blood pressure: (1) Primary low blood pressure; (2) high blood pressure; (3) secondary low blood pressure; (4) with the extra classification of constitutional low arterial tension, to include part of a particular class of people that has always been troublesome to place, and which includes many individuals of Dr. James Mackenzie's disease, which he called "X disease."

Under primary low blood pressure are included those who are suffering from lack of tension because of primary weakness of the heart, the relaxing effect of general disease, and, indeed, all instances in which the pressure-maintaining mechanism has failed or is debilitated, and in which there is no previous history of high blood pressure. The latter is a very imperfect distinction, as it profoundly influences the philosophy of treatment.

Primary low blood pressure as such does not demand any treatment, and one of the constant warnings that must be given to all those whose experience in the treatment of the sick is less than very great is, that the heart and circulation must not be stimulated for the purpose of rendering the pulse more interesting to feel.

The circulation of the blood is to be estimated by concomitant phenomena; and under conditions of slight pressure in the arteries, with very little resistance in the blood stream, the circulation may be very good, while the waves in the

circulation which constitute the pulse may be but slightly palpable.

Much harm is done by the injudicious use of drugs in primary low blood pressure, particularly in supposed emergencies in the operating room. A good friend of mine, an eminent surgeon, Dr. H. G. Wetherill, of Colorado, has written an eloquent appeal to surgeons on these points, and I, myself have dwelt upon the matter in a recent revision of the "Handbook of the Society for Instruction in First Aid to the Injured." It is very fortunate, indeed, that there are so few drugs that have a direct action upon the heart; and it is also fortunate that the physiologic effect of large doses of digitalis often given to persons suffering from shock is delayed until the person is able to stand them. Primary low blood pressure is often enough a conservative condition meaning that the heart and circulatory system, in general, are in a condition of repose, during which they are recovering from the effects of disease or the shock of an accident. All observers know that hearts almost invariably fail by becoming more and more rapid, and that failure, by becoming slower and slower and more feeble, is very rare, except in the presence of some definite toxæmia. Thus it appears that low blood pressure is ordinarily not a circulatory disease as such, but a circulatory expression of a general condition.

The second classification is high blood pressure. This is a topic which is nearly co-extensive with the whole scope of the book, so that it cannot be completely treated under this heading. As the name implies, it means an elevation of blood pressure above normal. It must also include persons in whom actual high blood pressure is temporarily absent, but where it has become habitual, and even necessary, for the maintenance of the circulation in the presence of defective organs. Low blood pressure due to defective organs has a tendency to drift into high pressure, as will be shown under the topic of auto-intoxication.

The third classification, which was definitely named by the author in his original monograph on "Blood Pressure," is, from the clinical standpoint, perhaps the most important of

them all, for it is this that brings the sufferer from serious disease under the care of the physician. It consists of a fall of pressure below the compensatory point in those who have lived for a long time with high blood pressure. This is illustrated numberless times a year in the emergencies that bring people suffering from serious arterial disease to hospitals, or confine them to their homes.

The point that causes the most confusion in the minds of the uninformed observers is, that the blood pressure measurement may be 20 or 30 mm. Hg above that of the average normal person, and yet may be 20 or 30 below the customary, and perhaps necessary, pressure of the person under observation, and any measures directed to restoring the pressure to normal, as defined in relation to well people, only aggravate the symptoms and increase the danger to the sick person. This knowledge of blood pressure relations has come to the profession gradually during the last fifteen years, and has resulted in much relief of suffering.

We speak of "determining the blood pressure" of a person who comes to us for treatment. It is a very simple matter to make a measurement of the blood tension in the circulation at the time that the person is in our office, or we are at his bedside, but to determine the constitutional demand of the same individual for blood pressure requires often weeks and months of study under varying conditions. Each sufferer from arteriosclerosis has a right blood pressure. Anything below this point is for that individual "low blood pressure"; anything above it is for that individual "high blood pressure." It is possible for any clinician to illustrate this by many examples from his own experience.

The technique of the use of blood pressure instruments is not complicated, though individual skill counts for a good deal. The personal equation, even when the ideas of the observers are the same, amounts to at least 5 mm. Hg. When one man reads pressure at the first return of the smallest pulse wave, when pressure is released after complete obliteration of the pulse, and another waits for the pulse, the variations will amount to 10 or 15 mm. Hg.

Then in serious high tension there is often an irritability of the brachial artery and of the circulation that makes each observation differ from the next. In such it is best to make one decisive estimation, and let it go at that. Then there are irregular pulses where a few waves come through very high, while most are lost much lower. In these the facts should be recorded.

The time is past when arteriosclerosis and high arterial tension are to be considered as necessarily associated together. Indeed, one does not have to go very far in the experience of the worker in this field of medicine without finding those with unmistakable evidence of thickening of the arteries, due

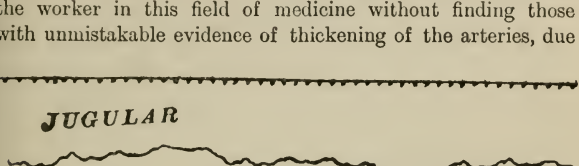

Fig. 5.—Low blood pressure in arteriosclerosis—case of Mr. D.

to increased connective tissue, without increased, or even diminished, blood pressure.

I saw a man recently in whom there had been a coincident development of arteriosclerosis and chronic neurasthenia. In this man, forty-one years of age, the blood pressure was 110 mm. Hg, while the sclerotic changes in his circulatory system were such as, without neurasthenia, would undoubtedly have given a high blood pressure.

This is not at all an uncommon combination of disease, and it would seem that the relaxing influence of that profound disturbance of the nervous system, that is called neurasthenia, had relaxed the tone of the median coat of the vessels. Neurasthenia has among its many definitions one which specifies it as pathologic fatigue. This definition has always appealed to me as containing a good deal of truth.

Furthermore, my own observation is that the best possible treatment of high arterial tension in those who have developed arteriosclerosis through nervous and chemical causes, is the physiologic fatiguing of the muscles through enforced exercise. Precautions against undue strain will suggest themselves. Thus the significance of low blood pressure in this group would seem to be that there is some influence acting upon the median coat of the blood vessels, resembling, in its physiologic effect, that which can be obtained in a measure by voluntarily acquired fatigue.

Another group showing relatively low blood pressure in arteriosclerosis is found in certain individuals in whom the causes of trouble have been eliminated. This is found in men who have overworked and worried, and perhaps overeaten and abused alcohol, who have adopted proper hygiene and have recovered from their high tension, though the sclerosis remains. High blood pressure is always the result of a physiologic demand, and when this physiologic demand ceases to exist the tension may recede, though the damage to the vessels may remain. Of course, this cannot be so in extreme conditions. In both the instances spoken of it is, in a measure, advantageous that the high tension does exist.

The third group of low blood pressure has a more sinister significance, and has been named by me secondary low blood pressure. It comes in arteriosclerotics when, while the demand for high tension continues to exist, the circulatory organs are no longer able to maintain sufficient tension.

For this reason one of the elementary lessons to be learned is, that in many instances high blood pressure spells safety, and nature is maintaining the integrity of the circulation in spite of obstacles. A person who has carried a blood pressure of 240 mm. Hg, and who has areas of the brain and probably of the other organs in which blood vessels have been damaged, would fare very badly with a blood pressure of 140 mm. Hg; while such a person reduced to 170 to 200 mm. Hg, being kept there principally by hygienic means, is capable of maintaining health and happiness for an almost indefinite period of time. But let some untoward

circumstance, such as dilatation of the heart, or general enfeeblement of the body, or a profound nervous shock, or some severe illness, cause a relatively low blood pressure, and the outlook immediately becomes very grave.

Many very competent clinical observers cannot agree with the laboratory experiments as to blood pressure and arteriosclerosis. Clinical workers from time to time see persons in whom the sphygmomanometer gives a very high reading, and yet in whom it is clinically evident that there is a failure of circulation. This is notably true in Bright's disease, and in some persons who are very sick in the course of valvular disease. I am accustomed to say, when this happens, that the person gives "a very high blood pressure measurement," without committing myself as to the condition of actual blood pressure.

On the other hand, I am convinced in nearly every instance, with the exception of the few examples spoken of above, that the blood pressure measurement is practically equal to the blood pressure.

As it is impossible to imitate in laboratory experiment the particular type of physiologic disturbance following a long-continued illness, the laboratory workers are justified in taking the ground they do. Both classes of observers are right, though they are looking at different things. In some people with cardiovascular disease the irritability of the arteries is extraordinary, so that the mere application of the cuff to the arm is enough to cause a spasm perceptible in the radial artery.

There are a great many points concerning blood pressure that are still matters of discussion, and there are a good many that cannot be settled categorically, and that must be a matter of individual judgment in the particular instance.

The danger into which one is apt to fall is to think that the blood pressure question is a very simple one,—that high pressure is simply something to be reduced, and that low pressure is something to be raised; that the drugs that raise pressure should be given in low blood pressure, and the drugs that reduce pressure should be given in high pressure. This is very far from the truth.

Pressure is controlled by a complicated mechanism. It is regulated by general chemical influence that affects the tonicity of the whole circulatory system. This is probably a matter of internal secretions. In all probability the secretion of the adrenals has to do with the maintenance of blood pressure, and the secretion of the thyroid gland has something to do with its diminution. Most certainly, experiments and observations point in that direction.

The chemical relation of blood pressure to the internal secretions is never to be overlooked.

Then, in addition to this, the blood pressure is under the control of the nervous system as a distributive measure through the sympathetic, dilator and contractor nerves, and it is also under the control of the nervous system as dependent upon the central station in the medulla. The blood-pressure-maintaining function of the medulla is well understood.

It is the lack of the appreciation of this threefold relationship that has led to so much confusion in the interpretation of blood pressure. But the same relation is found when we come to study the heart-beat. We find the heart-beat dependent upon a chemical cause that is constantly active in the heart itself. We find the heart-beat influenced by the sympathetic nerves, and influenced by accelerator and depressor nerves.

As I have often remarked, we cannot separate the heart and blood vessels into different organs. They are all parts of one mechanism that has been differentiated in the course of evolution. We must form a mental picture of the heart and blood vessels as one organ.

Nature has thus provided for a maintenance of the blood pressure, both general and local. The circulation of the blood depends upon the difference in pressure in one part of the body or another. When there is a demand for an increased blood pressure in any part of the body, the blood pressure in that part of the body is reduced by a relaxation of the blood vessels, and at the same time the heart is stimulated to greater work so as to increase the blood pressure in the aorta

and arteries, and immediately there is a rapid flow of blood to the part where the blood is required.

The blood-pressure-producing arrangement is very sensitive, and responds quickly to any demand for blood pressure. Not only this, but it ceases to respond when the demand for blood pressure is removed.

These are very important classifications, because one of the great vices of the day in treating cardiovascular disease is the injudicious interference with compensatory pressure—the reduction of blood pressure which nature has tried to maintain for some particular reason, or the attempt to raise blood pressure when there is no real need for an increased blood pressure.

An example of a man with very high blood pressure who, after much miscellaneous advice and experiments with various forms of treatment, finally settled down to a fairly comfortable existence through the adherence to a strict regimen, was Professor B.

He was a short, stout, blonde man, with blue eyes, who said that his father had lived to the age of seventy-one and had died of acute congestion of the lungs; his mother had died at thirty-nine of some intestinal trouble. He had never had any definite severe illness in his life, but had always considered himself gouty. He was a very hard worker, smoked cigarettes to excess, used alcohol in moderation, had no gastric symptoms, appetite good, bowels regular. He would have considered himself well had it not been for what he described as terrific pains in his head and some shortness of breath. He had been told that his blood pressure was 200 mm. Hg, and that he must drink large quantities of water to flush the kidneys. His oculist had also told him that there were signs of arteriosclerosis in the fundus.

The Physical Examination.—The first examination showed a blood pressure of 180 mm. Hg, but this must have been an accidental fall, because on no subsequent occasion was it as low as this. His heart was hypertrophied; he had a blowing, systolic murmur over the base; the lungs were clear.

Shortly after his first visit he went to Europe, and returned in the fall very much improved. He went back to work, and at that time his blood pressure was down to 180 mm. Hg. During the following winter he did not adhere strictly to his diet, but nevertheless got along fairly well. Toward spring his condition was not at all satisfactory, the head pains being very severe and the blood pressure remaining around 200 mm. Hg.

During the summer he went to the Battle Creek Sanatorium, which helped him a good deal physically, and convinced him of the importance of diet.

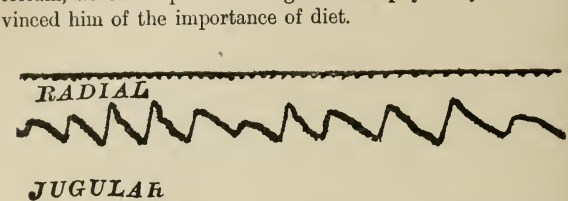

Fig. 6.—Polygraph tracing from Professor B.—case of very high blood pressure.

The following fall he was persuaded to take high-frequency electricity by someone who held out prospects that it would improve the condition of his arteries. The immediate effect was to give him a certain sense of comfort, but in a short time he developed marked signs of auto-intoxication, and when examined he had a blood pressure measurement of 230 mm. Hg, severe occipital headaches, pain in the left hand, arm and back; with this there was marked depression. (Fig. 6 shows tracing at this time.)

He was told that the artificial reduction in blood pressure had upset the compensatory balance of his circulation and had led to defective kidney and liver function, and that he had tried a dangerous experiment. He was very penitent for having tried the experiment without advice, and agreed to

follow a very strict regimen. He did indeed follow a strict regimen, and acknowledged that he had never been so well in the two years he had been under observation.

He was put upon a carefully planned cure—a few-protein diet, everything to be excluded in the way of eggs, fish, meat and soups, the nitrogen being supplied by cheese. He was told to take a full dose of castor oil and return in two days. He

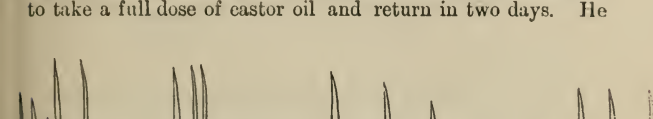

Fig. 7.—Radial tracing from a patient with aortic regurgitation during an attack of fibrillation of the auricle.

did so, and at this time was given another dose of castor oil, and told to take a third dose two days later. At the end of a week he came back—a few days after the last dose of castor oil—saying that he felt like a new man, and that he had been sticking to his diet and exercise; he played golf for exercise.

Since that time this man has not departed from his

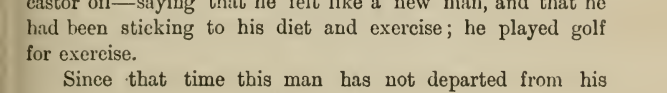

Fig. 8.—Radial tracing from the same patient three days later after recovery from the attack.

regimen, and is able to do a great deal of arduous work, and is very comfortable indeed.

On account of the presence of traces of albumin at times in his urine, and the almost constant presence of casts, this type of disease is classed by many as nephritis, but as the heart and blood vessels are equally and simultaneously involved, it appears to me that arteriosclerosis is a better name.

In the causation we have the possibility of quite a number of factors,—tobacco, hard work of an exacting mental kind,—but there is no particular period characterized by a severe

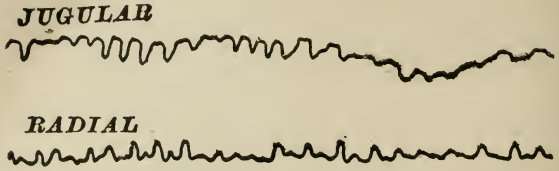

FIG. 9.—Tracing by the Mackenzie polygraph, from a case of fibrillation of the auricle that has been under the author's observation for the past three years.

illness from which we can trace the sensitization to proteins.

The history of the man's health, before and after the institution of the diet, leaves no doubt in his mind or my own of the true nature of his disease.

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PLATE VIII.

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VII

HEART COMPLICATIONS OF ARTERIOSCLEROSIS

The heart often bears the brunt of the battle in arteriosclerosis. Not only has it to contend with the difficulties of circulation, but according to the author's theory it suffers from the same damaging influence that involves the arteries.

The most elementary change in the heart in arteriosclerosis is hypertrophy. This, at first thought, is put down as purely the result of high tension, but more careful study shows that it occurs independently of this cause, and one must partly abandon the purely mechanical idea. However this may be, there is no true arteriosclerosis that is not accompanied by an increase in the size of the heart before the condition has gone on very long.

Involvement of the heart muscle in the results of the irritation of the cells of the body by the toxic agent that causes arteriosclerosis is almost universal, so that some præcordial distress is an almost constant symptom of this clinical syndrome.

Frequently enough, the auricle being the most vulnerable, as well as the most highly organized, portion of the heart suffers particularly. This results frequently enough in irregularities; of these, fibrillation has of late years become known to us.

This condition has a twofold relationship to arteriosclerosis. In the first place, it frequently develops as a result of the same cause as arteriosclerosis, namely, chronic poisoning from perverted food products; and secondly, as a result of the cardiac stress involved by prolonged high blood pressure often aggravated by some extra strain.

We are indebted to laboratory experimentation in pathological physiology for clearer views on many points in cardiovascular disease. In most instances this has been merely a classification of ideas that already existed, so that it is not easy to define any particular point for which we are entirely indebted to this work.

Our information of fibrillation of the auricle comes as near as anything to being entirely dependent upon laboratory observation. It has been a familiar observation in laboratory experimentation on animals that death of the heart is preceded by a condition of delirium cordis in which there seems to be a great number of irregular contractions of various fibres, without any efficient contractions of the auricle or ventricle.

The clinical importance of this familiar observation was not known until quite recently, but it is found that under certain conditions the auricle alone may be involved in this remarkable form of muscular activity to which the name "fibrillation" has been given; and it was observed that when this happened, the action of the ventricle caused an arterial pulsation very closely resembling the irregularity found in many of those suffering from a temporary break-down of the heart, and also in many with persistent irregularity of the pulse. This, with the study of polygraph tracings, has led to the conclusion that fibrillation of the auricle is a fairly frequent clinical phenomenon. In a brilliant course of lectures, delivered by Dr. A. R. Cushny during the winter of 1910–11, in New York, he made the statement that this condition existed in upward of one-half of the serious heart conditions admitted to hospital wards.

The fibrillating auricle transmits to the ventricle a large number of impulses. The ventricle, of course, can only respond to a few of these, and when it has responded it becomes refractory to impulses for a certain length of time. However, it responds to the next impulse that happens to come after the refractory period is recovered from. This very beautifully accounts for the fact that, though there are a great number of irregular contractions of the auricle transmitted to the ventricle, yet the ventricle contracts only a

relatively moderate number of times, and very irregularly. In treatment we endeavour to increase the tonicity of the ventricle and so steady it, and also create a partial heart-block which delays and cuts off some of the many impulses from the auricle. When this is accomplished the improvement in the condition of the patient is remarkable. When this inco-ordinate or vermicular action of the cardiac muscle-bundles occurs in the ventricle, the ventricle stops, and there only remains this trembling action of the muscle bundles; the ventricle does not empty itself, and is therefore useless as an organ of circulation.

It seems probable that some instances of sudden death are really fibrillation of the ventricle rather than true asystole Too large doses of digitalis may cause fibrillation of the ventricle instead of the picture of tonic contraction that we have always carried in our minds as death from digitalis poisoning. The heart can still carry on its work, though in a poor manner, when the auricle is paralyzed, but a fibrillating auricle causes great irregularity of the ventricle.

What amounts to definite knowledge of fibrillation only dates back a year or two, and is not yet known to the general profession. However, when it is once recognized and its true nature understood, its existence will, I am sure, be immediately accepted, and it will explain very clearly what is happening in many irregular hearts that have been very puzzling in the past.

The polygraph tracings are quite characteristic, but like all venous pulse tracings they are difficult to understand until after one has given a good deal of attention to them. We always thought in these cases that we had failed to get a good venous tracing because it was so hard to analyse the curve, but now we know the reason we did not find the A (auricular) wave was that it did not exist. What impresses one in looking at these venous curves is the striking similarity to the radial curve, which is entirely at variance with a normal tracing, so a good name for it is the "ventricular type of venous pulse," the auricle being practically inactive; the only impulse transmitted to the vein is that from the

ventricle, and naturally the prominent wave falls at the same time as the ventricular contraction, while, of course, the A wave or auricle wave in the normal jugular pulse comes before the ventricular contraction.

However, in many instances a great number of small waves has been observed, amounting to from 400 to 900 in a minute, corresponding to the same number of waves that can be obtained in an animal in which this condition of fibrillation of the auricle is artificially produced. Dr. A. R. Cushny told of a very remarkable confirmation of this theory which was attained in a horse which was afflicted with the clinical signs of fibrillation of the auricle. As we know, the heart action persists a short time after the death of an animal when killed by some cause outside of the heart. This horse, which was afflicted with an irregular heart corresponding to that of a human being, was shot after due preparation, and the heart was rapidly exposed and examined, and, true to their surmise, this condition of fibrillation of the auricle with an irregular ventricular action was directly observed.

Digitalis has no effect upon the auricle, except that it may render the fibrillation finer. Its benefit, as already pointed out, exists in its effect upon the bundle of His and other transmitting structures, and upon the tonicity of the ventricle.

It is often said that these very abstruse methods of examination into heart disease belong only to the domain of the specialist. It is absolutely true that no one in general practice could take the time to study cardiac arhythmia very closely, fibrillation of the auricle being only one side of the subject. However, when the matter has been studied by the specialist and pointed out, they are not so hard to discover, though, of course, the diagnosis must be definitely confirmed by someone with technical experience.

When, moreover, we realize that fibrillation exists in more than half of all the very serious hospital cases presenting an irregular pulse, together with symptoms of heart failure, dropsy, shortness of breath, and tenderness over the liver, and when it is realized that this is about the only disease

that causes absolute irregularity, it can be seen that it is not so difficult to discover. In some examinations the sphygmograph is enough. If a tracing of the pulse shows absolute irregularity, so that no two beats are alike and the beats never come at regular intervals, it may be assumed that it is the auricle that is at fault. In all the other irregularities there is some law discoverable with relation to the occurrence of the impulses, as they are very apt to occur in groups. For instance, in extra systole, which is perhaps the commonest form of irregularity, it is noticed that there is a beat interposed between the natural beats, followed by a correspondingly long pause of the heart, but the rhythm is resumed after this.

The following few simple points in the physiology of the heart I assume are familiar to all readers, but they are worth recapitulating. In the normal heart action the contraction of the heart originates in the auricle and passes through the bundle of His to the ventricle, so that the auricle contracts and then the ventricle, the ventricular contraction depending upon the impulse from the auricle. However, the ventricle has the power of originating contractions of its own, but the natural contractions of the ventricle are much slower—perhaps thirty to the minute—than those which ordinarily originate in the auricle. It is also well to remember that the ventricle is the essential part of the heart, and that the circulation is carried on fairly well without the use of the auricle. If this were not so, those with fibrillation would immediately succumb. Of course, the best proof of this independent ventricular contraction is found in Adams-Stokes disease, in which the transmission from the auricle to the ventricle is stopped. Then the ventricle beats independently of the auricle. Perhaps one of the most typical examples on record is one that happened in my service in the hospital some years ago, which was published in the *American Journal of Medical Sciences* for January 1910, and is referred to later in this chapter.

Also, remember that the ventricle loses its power to contract immediately after it has contracted, and this power

is only recovered after a certain interval; this is called the "refractory period." It is only on account of this property that the ventricle does not attempt to contract after all impulses that come from the fibrillating auricle. It only contracts to the first impulse that reaches it after it has recovered from its refractory period. So there is a limit to the number of impulses to which the healthy ventricle can respond, and the rest are lost.

To recapitulate, I should say, using very common language, that fibrillation of the auricle practically amounts to a trembling palsy of part of the heart, but a palsy that casts an influence over the healthy part of the heart. The healthy part of the heart is perfectly able and willing to contract regularly, but at a very slow rate. The paralyzed part of the heart is constantly lashing the healthy part of the heart into contractions, but when the heart has contracted once it refuses to contract again until after it has had a rest, and then as soon as it is able to it contracts to the next impulse. If we could cut the bundle of His in fibrillation of the auricle the heart would act regularly, but very slowly.

In clinical medicine this affection, when understood, gives brilliant results in response to treatment. It is always to be suspected when the pulse is very rapid and irregular.

The next and a rare cardiac complication of arteriosclerosis is complete heart-block. The author has had four instances of this disorder in its most typical form, and each occurred in advanced arteriosclerosis. In one the heart was examined and a nodule found in the course of the bundle of His. The following notes are abridged from the report of the first in the *American Journal of Medical Sciences*, January 1910.

Thomas M., a watchman, aged seventy-five years, was admitted to the Lincoln Hospital, on 13th October 1908, and died 22nd October 1908. His family history was negative. He had previously had no important illness, except measles, whooping-cough, and small-pox when a child. Later, he had muscular rheumatism, and twenty-five years ago he had a sun-stroke, but had always been considered a

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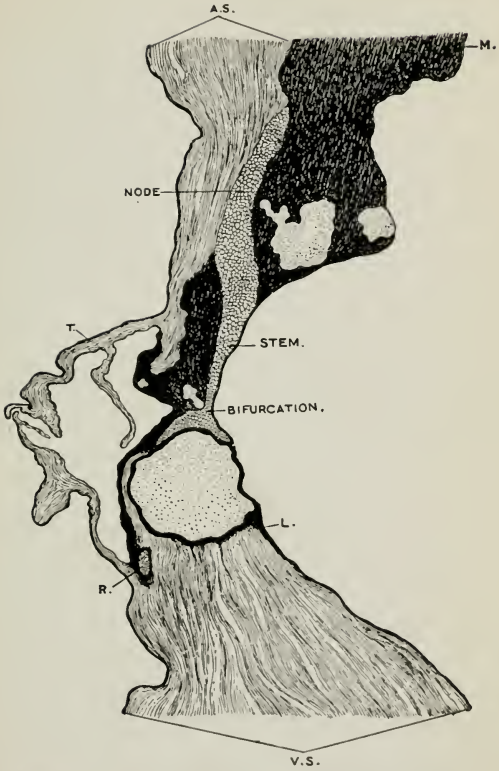
PLATE IX.



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healthy, strong, hard-working Irishman. He drank moderately Syphilitic history was denied.

On 12th October, while in bed, he felt as though he was whirled around, and had a great buzzing in his ears, especially in his right one, in which he had been growing gradually deaf. After that he had three similar attacks, and came to the hospital complaining chiefly of these attacks, and of feeling weak. He said that the attacks and vertigo came on without premonition, and that between the attacks he felt perfectly well, excepting that he was weak.

On admission, a physical examination made by my house physician, Dr. Benjamin W. Seaman, and subsequently reviewed by me, showed a patient fairly well developed but poorly nourished, sitting up in bed with an alert and intelligent expression. He was able to answer questions perfectly, and gave a clear account of his symptoms. An examination of the chest showed the heart apex in the fifth space, three and a half inches from the median line. The heart was regular in action, except for occasional differences in the interval between beats, and there were no murmurs. Above the right clavicle, venous pulsations were visible two or three times more frequent than the apex beat. The eyes reacted to light and accommodation. The tongue was protruded straight, and was deeply coated. The liver was not made out enlarged. The extremities were negative except that the knee-jerk was not obtained. No further physical signs of disease were obtained. The radial artery was not thickened, even to the degree that would be expected in a patient of his age.

The urine examinations revealed a specific gravity of 1020 to 1024, no albumin, no sugar; urea, 1·8 per cent. (9·1 grams in the twenty-four hours).

The diagnosis of Adams-Stokes disease was unhesitatingly made by all those who observed the patient. During his stay in the hospital he was treated with potassium iodide, but his syncopal attacks recurred daily, and sometimes several times during the day. The iodide caused symptoms of iodism, and was discontinued. He was under observation

for nine days, and at the end of that time became delirious, and one morning the pulse dropped to 20, the respirations rose to 28, his temperature fell to 90 degrees, and he died suddenly.

The pulse-respiration ratio, recorded while under observation at intervals of four to eight hours, was as follows: 38 to 20, 40 to 22, 36 to 24, 36 to 24, 32 to 20, 30 to 22, 32 to 20, 34 to 24, 32 to 20, 36 to 22, 34 to 28, 30 to 20, 34 to 18, 30 to 20, 32 to 18, 34 to 28, 32 to 22, 30 to 20, 30 to 20, 28 to 20, 30 to 20, 30 to 20, 32 to 24, 32 to 24, 28 to 20, 34 to 24, 32 to 24, 36 to 24, 30 to 20, 32 to 24, 32 to 24, 28 to 29, 26 to 24, 30 to 24, 32 to

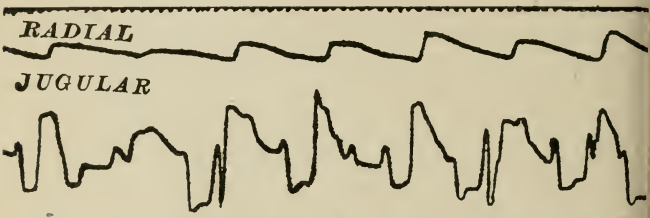

FIG. 10.—Polygraph tracing from Mr. M. R., showing complete heart-block.

20, 28 to 24, 28 to 24, 28 to 24, 28 to 24, 26 to 20, 30 to 25, 26 to 20, 28 to 26, 24 to 28, 20 to 28.

The next to be described is a gentleman who is still under my care, and in spite of his advanced arteriosclerosis and complete heart-block he enjoys a measure of health.

Mr. M. R., aged seventy-three, was referred to me by the late Dr. William R. Hitchcock, of New York. He complained of shortness of breath and dizziness, on account of which he had fallen down on several occasions. He also knew that he had a pulse that was commonly about 28 to the minute.

His father was killed in war at the age of sixty-one, and his mother had died at seventy-two. He had seven brothers and sisters all older than himself, who were dead, one sister having lived to the age of seventy-three.

He was a tall brunette, blue eyes, and had always enjoyed good health. He had never drunk to excess, and tobacco had always caused nausea when he had tried to learn to smoke. He had been a musician by profession, but had lost his hearing through having got in the way of a volley of musketry that was directed towards him while leading the band at a performance of "The Rose of the Ranchero."

On examination, he appeared to be a well-nourished man weighing 180 pounds. He showed a very decided double aortic murmur; pulse was 32—perfectly regular. He had noticed his dizziness for about six months, but had not been subject to the severe falling attacks for so long.

He had been under the care of Dr. Oliver L. Austin, of Tuckahoe, who had prescribed chloral hydrate, 5 grains, four times a day, which he had taken continuously, and under the influence of which he had been free from syncopal attacks; this is a very interesting point.

Another example, which was very like this one, was seen in consultation with Dr. J. H. M. A. von Tiling, of Poughkeepsie. This gentleman, a clergyman, aged seventy-seven, had had a fainting attack four months before, and some time previous to my seeing him an extremely slow pulse had been noticed. His blood pressure was 200 mm. Hg; pulse, 32; and at the time I saw him he was so dizzy that he could not sit up at all. There was a visible pulsation of the supraclavicular fossa, estimated at 68 to 70.

The close relationship between the pulse and the respiration ratio is the same as in the first instance, in which the calcareous nodule was found after death. This ratio was as follows:—

December 14th: 30 to 28, 30 to 28, 28 to 28, 28 to 28, 28 to 28, 30 to 28, 33 to 28, 30 to 28, 30 to 28, 30 to 28, 33 to 28, 28 to 28.

December 15th: 26 to 26, 26 to 28, 26 to 26, 26 to 24, 30 to 24, 28 to 24, 27 to 24, 26 to 26, 24 to 24, 24 to 28, 28 to 28.

December 16th: 28 to 26, 29 to 26, 30 to 26, 28 to 26, 28 to 26.

December 17th: 28 to 26, 30 to 26, 29 to 26, 31 to 24, 30 to 24, 32 to 26, 35 to 26, 30 to 26.

December 18th: 30 to 26, 28 to 24, 31 to 24, 30 to 26, 30 to 26.

December 19th: 28 to 30, 28 to 24, 28 to 24, 29 to 24.

December 20th: 31 to 24, 30 to 24, 30 to 26.

December 21st: 30 to 26, 30 to 26, 32 to 24.

Auricular flutter as a complication of arteriosclerosis is a fairly frequent observation. Under digitalis the picture changes to fibrillation. Such an example was Miss X., forty-six years of age, a very old patient of mine, who consulted me on 6th December 1912, complaining that since summer she had the feeling of a lump in her throat, and had

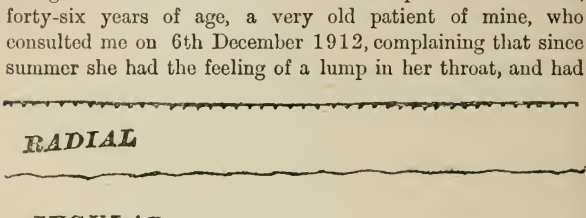

FIG. 11.—Polygraph tracing of Miss X. before treatment.

been quite short of breath. Her heart was very rapid though regular, and after careful study her condition was assigned to the category of auricular flutter.

She was put on a few-protein diet and her general condition watched, and, after a little rest, upon the infusion of digitalis. When she became digitalized the heart was reduced to 68, and was decidedly irregular. It has been necessary to continue the digitalis in small doses ever since, though her condition is considerably improved.

The recognition of auricular flutter is a distinct addition to our resources in explaining precisely the heart complications of arteriosclerosis. It clears up some points that were clinically obscure in the field, which is also occupied by paroxysmal tachycardia.

PLATE X.

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PLATE XI.

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In arteriosclerosis of long standing, if things are not going well, the heart becomes dilated, and there develops an insufficiency of the mitral valve. This has been happily expressed by the saying that "a person has become mitralized." When this happens, every known hygienic measure must be brought to bear on the situation, and when all other things fail digitalis must be resorted to.

Digitalis is the trump card in the treatment of cardiovascular disease, and when it has been played the hand has been to that extent weakened, because there is no other drug that can take its place. Then comes into play what has been recognized by many of the greatest clinicians as one of the most difficult arts, that of the proper use of digitalis. The slow action that is so characteristic of digitalis makes great foresight necessary in its use, and the dose that we are giving to-day is only to be traced in the therapeutic results of to-morrow or the next day. Boldly used at first till the heart is "digitalized," and with caution for months or years if necessary, it is one of the delights of medical art.

Thus a gentleman under my care at the present time whose recovery under digitalis from what was supposed to be, and which in a legal paper has been certified as, an absolutely fatal disease, is symptomatically well because he takes the infusion of digitalis equivalent to about a grain of the drug a day, and does not stop it at any time.

The unhappy results of the abuse of digitalis in arteriosclerosis are only equalled by the happy results when administered properly to persons whose condition demands it.

VIII

THE TREATMENT OF ARTERIOSCLEROSIS

The cure of chronic disease requires patience, skill, strength and character, and nowhere more than in the treatment of arteriosclerosis. Its long course rules the time-server from success except as a temporary adviser. Anything but frankness and truth brings its own penalty, so physicians must not promise the impossible. On the other hand, a physician who has not faith should not undertake such work, nor should the man who is not willing to make a careful analysis of each person's needs and who cannot fight a bout with death to a finish. The man who does not know when he is beaten often surprises everyone by being on the top rejoicing in the restoration of the sick one, when all the doctors who gave up hope are busy making excuses and prophesying the short duration of the "remission."

While writing this chapter my publisher (perhaps to encourage me) sent me a clipping from a journal. I like the spirit of the old soldier who wrote it so much that I cannot refrain from giving it just as it is.

"*February* 1913.

"Editor, *Medical Summary.*—By your request I send you a short article on what is called arteriosclerosis, a disease which has been recognized by the profession for years, and which is the indirect cause of many deaths to-day, simply because it is not correctly understood or treated by doctors who have not given it careful study. It is a disease of the arteries, veins and nerves, and affects the lymphatic system.

"Lobstein, seventy-five years ago, called the attention

of the profession to it. In more recent years Dr. Warfield, of St. Louis, has furnished the profession with a small volume of very pertinent thoughts and practical ideas. So has Dr. Lorand, and yet how few practitioners have made it a personal study. It has been very ably discussed in the Surgical Journal of the U.S. Ex-Surgeons at their annual meetings. It is now regarded by them as one of the most frequent pensionable disabilities of the old ex-soldier.

"It is a subacute and chronic disease of the arteries, characterized by thickening of the walls of the blood vessels, the initial lesion being in the middle or muscular coat, leading to, not infrequently, calcification and to the formation of minute aneurysms along the vessels. Almost without exception the capillaries are involved in the morbid process; even the veins are also markedly thickened, which is a vascular sclerosis or angio-neurosis. The whole vascular system, including the heart, is involved.

"It was my pleasure to study this disease under the senior Gross, Joseph Leidy, Agnew, Crosby, Sayre, Ridgeway, Wyeth, and Dr. T. H. Andrews in 1867 and 1871, and at the clinics of Stille, Pancoast and Da Costa, all the ablest men in their days, and the immortal Henry Smith. Several of these men were arteriosclerotics, and were conscious of the fact. We examined the eyes of the elder Dr. Gross, with Dr. R. J. Levis, of the Wills Ophthalmic Hospital, and while the arcus senilis was very evident, it did not shorten his days, because he was temperate in all things.

"Since then I have given it close study and found it always pays well to make an autopsy of every case, to study its pathology closely and to treat the symptoms intelligently. Bear in mind, it is a disease of advanced age; it occurs among all classes, and it is possible to prolong the life of your patient by wise counsel and teaching them to avoid excesses of all kinds, such as violent exercise. Take off the tension of the arteries affected by rest and cheerfulness; keep the mind employed by change of pursuits. Some drugs will assist you, as the avena sativa; saturated solution of chlorate of potassium and aromatic spirits of ammonia. I

treated one patient for thirty years with the potash solution. He died in his ninety-sixth year from a trauma. Any medicine that equalizes the general circulation will help your patient. Amyl nitrate judiciously used will relieve in many urgent cases by inhalation at long intervals. Don't alarm your patients, or allow some meddlesome nincompoop to interfere with your treatment. Care for your patient yourself; it pays to give them the closest attention. I have found the pain in an attack to be like that often in locomotor ataxia. Lightning pain felt at the base of the brain at junction of cervical and dorsal vertebræ, or beneath the clavicles and along the great sympathetic. Make a clear differential diagnosis, don't confuse or confound it with lithæmic symptoms; don't mistake it for ossific aortic troubles. While ossification is often present, don't look for it in every case. Proper prophylaxis is very important in successful treatment. For God's sake, don't ever expose your ignorance and stultify yourself by telling your patient you can do him or her no good by treatment. I abominate a fool in the profession or in the sick-room. Talk but little, but do something. Common sense in an uncommon degree is what is demanded in successful cases. I am proud of my record in these cases. I have always enjoyed the full confidence of my patients, and I have prolonged their lives by advice and treatment.

"The doctor who is a sceptic or a misanthrope ought never to take such cases. He will always fail. Use the knife only where you can release tension or remove an obstructing spicula or enlarged gland.

"The carotids, subscapular, cœliac artery, mesenteric, temporal, ciliary, and the circle of Willis are the vessels most frequently involved. Passiflora incarnata is a useful medicine in many cases.

"Not all of your patients can stand a cold bath, unless you prepare them by mild stimulation, tepid spongings, massage in the tub. Take your time and remove all ligatures, anything that prevents the free passage in the constricted tube. Keep in your mind's eye the condition of your patient

at all times. Death from carelessness and over-officiousness is often the sad result. Too much meats avoid, interdict pork and such-like. Potassium iodide will often relieve the dyspnœa, etc. Blood pressure produces vertigo, which must be relieved, even sometimes by bleeding or cupping. Now don't get scared at this suggestion. I have saved several useful lives by it, and never lost one by it.

"Be strong, be vigilant, be brave, encourage your patient by words of cheer. I have saved several by telling them they could not die if they tried to. You may expect and anticipate the envy of the two-by-four man who has but little grey matter and never thinks for himself. Don't ask him to do what is impossible for him to do—think.

"We wish our profession could get rid of the vast host of routinists, who never think out the case themselves.

"Well, sir, I have written enough. I refer those who wish to read up on this all-important subject to Erlanger, Hirschfelder, and others.

"C. W. Watts, M.D."

"President Board U.S. Examining Surgeons, and Secretary-Treasurer, Howard County Medical Association, Fayette, Mo."

One of the hardest things to impress on those whose physical condition demands medical supervision is that treatment must be adapted to the particular needs of the particular time, and that in one and the same individual the combination of rest in bed and out-of-door exercise may be desirable.

The occasional complete rest in bed in the course of arteriosclerosis is more often advisable than easy to enforce. It is just as much a matter of treatment as a dose of medicine or a course of exercise.

The question of expense of treatment should not be a matter of importance in arteriosclerosis. The only really expensive and specific treatment is travel; this benefits most people. The food that is allowed happens to be the cheapest kind of food, and the best exercise is walking, which is also the cheapest form of exercise; and it is hard to think of

any drug that is useful in arteriosclerosis that costs very much money. So inexpensive is the proper diet for arteriosclerosis that a gentleman of great wealth said he felt compelled to give the waiter a tip of a dollar before he ordered his meal, so that he would not be considered mean.

Persons suffering from arteriosclerosis are often apprehensive and nervous and subject to all kinds of medical fads. For this reason these people and their friends will find the carefully considered advice of the very highest authority in their neighbourhood much less expensive in the long run. Of the familiar family doctor they are accustomed to receive a prescription and some tangible form of treatment, but make light of his advice. From the specialist or the internist of high standing they will accept simple advice and the plain truth. The family physician is a great man to those in relation to whom he stands as an occasional consultant, but to his old patients he has lost his standing by familiarity. He may be a fine physician, but he does not get a chance to be big. From their own doctor is demanded an elaborate form of treatment, while from the specialist the simpler form of treatment is accepted.

This is not as it ought to be, but who can change human nature?

The treatment of long-continued diseases naturally divides itself into three stages: the stage of preliminary adjustment, the stage of continuous care, and the stage of supervision.

In the preliminary stage the most important task is to restore the sufferer to his average state of health. People wish to be relieved of pain, shortness of breath, weakness and apprehension. The physician finds it necessary to regulate food and prevent auto-intoxication and food poisoning, to regulate blood pressure and allay groundless fear.

The best method of detoxication is by serial doses of castor oil. One ounce, or its equivalent, two tablespoonfuls, should be taken and a like dose at forty-eight-hour intervals

until three have been taken. I like the following mixture that was first brought to my notice by Dr. Gordon K. Dickinson, of Christ's Hospital, Jersey City.

Tincture of Iodine .	M. x
Menthol . . .	gr. ij
Ol Ricini . .	ʒj

Take at one dose.

Of all the marvels from treatment there is none greater than the improvement in condition in previously untreated and undieted arteriosclerosis, especially of the type with abdominal venous stasis, after the serial doses of castor oil.

In the meantime, rest and quiet is ordered on the ground of "a course of treatment," and all animal protein food—eggs, fish, meat, and soups—are forbidden. All medication, except as above, is stopped for the time being, except such mild remedies as comfort may demand. The rest and the oil are the important measures.

If the circulation in the lungs, kidneys and liver does not show marked improvement, then digitalis may be used to bring about a balancing of the tonicity of the various parts of the circulation.

It is a far cry from the one-time teaching that digitalis was out of place in those suffering from arteriosclerosis and the belief of to-day. And yet, just as the painter may be judged by his skill in the use of his brush, so may a man be judged by his art in the use of digitalis and those measures which produce the digitalis effect.

In the course of time, unless the progress of the disease be checked, every patient suffering from arteriosclerosis reaches what I have elsewhere discussed, "the digitalis stage," and, when that time comes, happy is the physician who is truly skilful in its use.

There may linger in the minds of some the notion that digitalis is very dangerous and is liable to lead to great elevation of blood pressure, with a consequential rupture of the blood vessels in the brain. As a matter of fact, this does not occur under suitable supervision.

I have put a great number of persons with arteriosclerosis and high blood pressures upon the infusion of digitalis and carried the dosage to the point where nausea, slowing of the pulse, or diarrhœa resulted. In none was blood pressure raised, except where there were signs of failing circulation, and when it was reasonable to suppose that a high pressure had previously existed. On the other hand, the sphygmanometer gave a lower reading in instances where it was supposed that a hypertonic contraction of the arteries had been compensatory to a failing heart.

On theoretical grounds digitalis has been objected to in arteriosclerosis, in the belief that it would raise blood pressure and endanger weakened arteries. Empirically, there are many cases of profound arterial degeneration in which digitalis is of value in supporting the circulation. Without regard to blood pressure, I have used digitalis cautiously now for years in secondary low blood pressure, even though the actual pressure was far above normal for a healthy person.

Persons with arteriosclerosis in a severe form develop habital pressure that they maintain as long as they are in a condition of well-being. Under some conditions the blood pressure rises a good deal higher, and under other conditions it falls.

Experimentally, in advanced arteriosclerosis I have never succeeded by means of digitalis in raising blood pressure above the habitual pressure, unless it was given for a long time. On the other hand, I have seen some pressures reduced, and I have often seen a pressure below the habitual pressure restored to the actual need.

Bearing in mind that digitalis has chiefly an influence on tonicity, and that tonicity is independent of all fibrous structures, it is easy to see why this is so. In advanced arteriosclerosis it should only be used under the most careful supervision, because the reserve force of the heart is often very small and response to digitalis must be limited. In unskilful hands it is capable of great harm, but it is a powerful remedy and when properly used cannot be spared.

In regard to digitalis, as to all other studies in cardio-

vascular disease, the unity of the physiology of the heart and blood vessels must ever be borne in mind, and what tends to affect tonicity of the heart muscle must also influence the middle muscular coats of the vessels. The result may not come as quickly to one as the other, and of this fact we may take advantage. I have often witnessed the contracted arteries of digitalis excess, as I have frequently, in former days, seen cardiac relaxation from nitrite excess.

One of the bugbears of my early practice was the cumulative effect of digitalis, and previous to the development of the myogenic theory this could not be otherwise. Now I know that what was called the cumulative effect is not only necessary and desirable, but must be attained if the true benefits of the drug are to be enjoyed. According to the myogenic theory, the effect of the nervous system is secondary to the power of the heart to originate contractions in its own fibres. In the heart there seems to be a continuous chemical process going on which produces a chemical substance which, when it reaches a certain degree of development, is responsible for stimulus production and excitability.

It would seem that digitalis modifies the chemistry of the heart much as an alkaline substance dropped into an acid mixture changes the reaction from acid to alkaline. In both instances, at a certain time, there is a change. The mixture becomes alkaline; the heart becomes digitalized. Digitalis is eliminated gradually, but at a fairly uniform rate, so to keep the heart under its influence more must be added. In practice, this knowledge leads to the free use of digitalis to the point of saturation and the cautious, continuous use in smaller amounts.

When the circulation is restored the digitalis is stopped, and may not be needed again for years if the stage of supervision is carried out. A person with arteriosclerosis should see his physician once a month and take a cure once a year. The cure should also be a vacation. When circumstances allow a visit to a cure resort, so much the better.

Nauheim, in Germany, is a delightful place for those

needing serious attention, and as a type of judicious treatment I cannot do better than discuss this place and its method. It has been a favourite place of study, and Professor Groedel, of Bad Nauheim, has made some notes for me.

We are convinced that brilliant results can be obtained in the earlier stage of arteriosclerosis by the Nauheim methods, which, when carried out in the proper spirit, counteract most of the causes of the condition. However, unlike cardiac dilatation, the improvement is not so easily appreciated by the person, who is unconscious, as a rule, of the progress of his disease.

People with arteriosclerosis may be divided into two sets. In the first division we place the disease before the establishment of an habitual high blood pressure—before there has been an injury to the brain through apoplexy, dilatation of the heart or marked impairment of the kidneys. Such, by an occasional repetition of a cure and adherence to the precepts, will have learned to retard the progress of the disease and enjoy good health to the end of their natural days. The second are those who have established an habitual high blood pressure and have suffered a dilatation of the heart, an attack of apoplexy or degeneration of the kidneys. These can be benefited, but at the cost of much more labour and a much stricter regimen, and as years advance prevention of a repetition of accidents becomes more and more difficult.

I have seen a man, the natural history of whose disease, under ordinary treatment, would have been completed in a few months, enjoy five years of comparative comfort on account of his training at Nauheim.

In these serious conditions, after a single visit to a cure resort, the treatment is better carried on at home. In milder conditions, where accidents have not occurred, people are better for a yearly cure.

[1] In treating patients with arteriosclerosis by the Nauheim carbonated salt-baths, we have to keep in mind that we should always take regard of blood pressure, because there

[1] Written for this chapter by Professor J. M. Groedel.

is a difference in the treatment of patients with a too high or a normal arterial tension.

Formerly physicians were afraid to give patients with arteriosclerosis baths of any kind, because they were of an opinion that these patients always had an increased pressure, and that baths—and especially carbonic acid baths—still more raised it. Our records show that in many cases of arteriosclerosis the blood pressure is normal, and that even in cases with increased arterial tension Nauheim baths can be given, if properly ordered, without raising blood pressure. This we demonstrated by experiments made at the Hydrotherapeutic Institute of the University of Munich with artificial carbonated baths. Dr. Theo and Dr. Franz Groedel proved it for the Nauheim baths by very strict observations with Riva-Rocci's apparatus, properly modified for this purpose. They stated: In the carbonic acid baths a supernormal arterial tension is at the beginning a little increased, four to seven millimetres of mercury, that is, not more than any physiological actions will do. This disappears after two or three minutes. Then the arterial tension decreases gradually, and goes down under the initial number from five to thirty millimetres of mercury. After the baths it goes up again slowly to the original number, whereas the diminution of the pulse rate, which shows itself during the bath, goes on for a longer time after the bath. But to avoid a high initial elevation of the arterial tension and a lasting or permanent one, we give the following directions for the baths in cases of high blood pressure. The temperature of the bath has to be kept near the point of indifference, that is, about from 93° to 95° F. We have always to begin with the half-bath, that is, the water not reaching higher than to the point of the sternum, gradually going up to the nipples. In many cases the amount of water can be increased little by little at each bath until a full bath is at length attained, but even then it is advisable to let the patient only submerge his body by degrees.

The content of the carbonic acid gas must be increased slowly, and accordingly the temperature can be lowered from 95° to 93°; the duration at the beginning, five minutes, can

be augmented gradually to ten minutes, not more. During the bath the exposed parts of the body are wrapped up, so as to prevent cooling. The patients must be warned against taking a chill after the bath, as that would produce a contraction of the cutaneous vessels with shivering, increase of the arterial tension and oppression of the heart. Placing cold bandages on the bather's head is often indicated.

How can baths help in cases of arteriosclerosis?

It is impossible to remove existing sclerotic degeneration by any means; we are, however, able to stop or retard the deleterious process. The first thing is, of course, the removal of all conditions disposing to arteriosclerosis. So treatment by baths is especially serviceable, if arteriosclerosis is combined with gout, chronic articular and muscular rheumatism, or neurasthenia. (But even a direct influence of the Nauheim baths on the sclerotic process, and with it a limitation of the disease, is possible.) When we consider that in arteriosclerosis a disturbance in the nutrition of the walls of the vessels must play an important part and that functional troubles of the vascular innervation are probably often the primary cause, we must come to the following conclusion: The acknowledged tonic effect of the baths on the nervous system has to be taken into special consideration for the vasomotor part of the process. Disordered nutrition in certain organs can no doubt be entirely removed, or at least improved, by means of baths; why not also disordered nutrition of the vascular system?

Of particular importance is a course of baths in cases of arteriosclerosis, when owing to this change the heart is no longer able to satisfy the increased claim on its functional activity. It is not necessary to repeat here what is stated about the tonic effect of the Nauheim baths on the weakened and insufficient heart. We can content ourselves with stating that with disordered circulation, also when this is caused by arteriosclerosis, the manifold consequences of cardiac insufficiency, if recent, very often disappear, and, if more advanced, can often be decidedly improved.

Baths are contraindicated for arteriosclerosis when there

is such a high degree of insufficiency of the cardiac muscle that drugs remain without any effect; secondly, when there were apoplectic fits repeatedly, or a single one recently. In this case—a single attack—baths may be tried when the fit has occurred more than a year previously. Then baths are contraindicated in cases of permanent cerebral giddiness, in cases of advanced aortic dilatation amounting to aneurysm (slighter degrees are not contraindicated), and finally when the arterial tension is higher than 200 mm. of mercury (Rechlinghausen's apparatus); angina pectoris, if there is not a so-called "permanent anginal state," gives no contraindication.

The mechanico-gymnastic treatment is of less importance for arteriosclerosis than the baths, and can only be applied to a limited extent. Resistance movements cannot be permitted in cases of a general arteriosclerosis in a high degree, and especially with high blood pressure. The increased energy of the heart action caused by the muscular exercise is only compensated in an incomplete manner by a corresponding dilatation of the arteries, and therefore a dangerous raising of blood pressure and a surcharging of the heart takes place. In cases not too advanced, or with relatively low arterial pressure, sometimes resisting exercises in a mild form are successfully used. A gentle, not too prolonged, general massage, as well as passive movements, are almost always permissible.

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Believing, as we do, that one of the principal causes of arteriosclerosis is dietary, we naturally feel that diet is of the

utmost importance, and yet it is difficult to lay down hard-and-fast rules. Each person must be considered by himself, though in general it may be considered as a cardinal rule that one who is subject to arteriosclerosis should limit his food to the needs of his body.

When a person has severe and advanced arteriosclerosis, particularly if he has suffered one of the accidents, he should eat five small meals a day, and limit his food to the plainest possible fare. The few-protein diet is discussed elsewhere.

[1] If there is a combination of gout or nephritis with arteriosclerosis, the examination of the urine, or the whole metabolism as regards the reduction of the secreted uric acid, nitrogen or chlorides, can give us hints for the prescription of diet. Eventually we have to give food with little chlorides, or no food forming uric acid or containing nitrogen.

In the treatment of arteriosclerosis the nitrites constitute a group of drugs producing a remarkable effect upon the blood vessels. They diminish tonicity in a very marked degree, and in this way reduce blood pressure. So long as blood pressure was regarded as a vicious symptom, rather than a compensatory phenomenon, it was supposed that in the nitrites we had a specific remedy. They were perhaps used more extensively than any set of remedies that were introduced about the time I studied medicine.

The belief in the value of the nitrites was reinforced by the surprising benefit that often appeared promptly upon their administration, and because of the relief of immediate symptoms they were used with the idea of producing a cure. Often, when they failed to relieve symptoms and the person became constantly more ill, the remedies were pushed still further, not infrequently to a harmful degree.

It seems to me now that when symptoms are due to a local spasm of the blood vessel (using the term to indicate a relative overtone) that the relief of this spasm by the nitrites in turn relieves symptoms; but when the drug is carried to the point of producing a general loss of tone in the circulation, the ultimate effect is harmful.

[1] Note by Professor J. M. Groedel.

So the axiom might be laid down in cardiovascular disease, that the nitrites should be used whenever they are found experimentally to benefit symptoms, but are never to be used for the sake of lowering a blood pressure that seems reasonable for the particular person.

It has truly been said that nothing worth knowing can be taught, and that medicine is an art that each must acquire for himself. Nevertheless, books are necessary in suggesting and correcting lines of thought. There is added satisfaction for those who have learned to find that others too have thought out the same problem in the same way.

In no department of medicine can more be accomplished

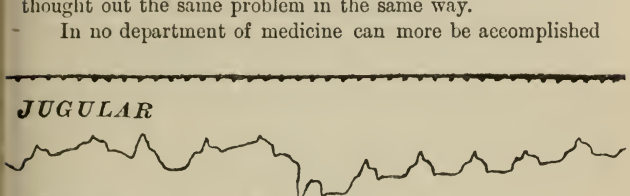

FIG. 12.—Polygraph tracing from Dr. M., showing a premature systole.

by medication based on clinical evolution (not symptoms alone) and pathologic physiology (not anatomy).

Laennec, uninformed as he was of the great discoveries of this century, spoke of prolonging lives fifteen or twenty years in spite of grave affections of the cardiovascular system. If Laennec could do this with the limited knowledge at his disposal, there should be no such limit now.

During the early, or presclerotic stage of arteriosclerosis, it is remarkable how in the course of a few days the pallor found in protein poisoning is relieved under the few-protein diet when the intestinal tract has been properly prepared. Distressing dyspnœa of toxic alimentary origin sometimes yields in a most astonishing manner.

As I write this chapter there stands in the corner of my

study a great box of oranges sent me by Dr. M., of Florida. When Dr. M. came to New York for treatment he was suffering from dyspnœa of this character, and was relieved principally by dietetic treatment.

Chloral is a valuable help in the management of arteriosclerosis, particularly when there is great hypertension. In repeated small doses over long periods of time it has proved of great service in giving comfort and allaying an irritative condition of the circulation, on the average giving a lower pressure without interfering with compensation, as often happens when the nitrites are used.

The relation of kidney disease to arteriosclerosis and the accompanying heart changes has been well understood by

FIG. 13.—Polygraph tracing showing a premature systole.

practical physicians for a good many years. Indeed, it must be over thirty years since anyone of experience has considered one condition apart from the other. In certain types of kidney disease there is a greater hypertension than is easily accounted for by the ordinary mechanism of compensation, so a number of authors have suggested that there is an elaboration of some internal secretion that acts upon the blood vessels. Personally, it has seemed to me that the compensatory phenomena acting through the already existing blood pressure mechanism was sufficient, without introducing a new factor into a supposed internal secretion from the kidney. The important point is to distinguish between examples of primary disease in the kidney, which are numerically few, and the complicating sclerosis of the kidney that is part of a general

arteriosclerosis. It is easy to make too much of the kidney.

A vast amount of literature has grown up around disease of the kidney, but as a practical matter the kidney as such is better without direct treatment in arteriosclerosis until such time as it becomes so prominent as to be a primary consideration. All those measures that are beneficial to the circulation in general are equally valuable for the kidney, which is really only a part of the circulation that is devoted to excretion. My opinion is that diuretics, which have a direct effect upon the kidney, constitute a very crude form of medication, and in the long run are seldom of advantage.

It seems foolish to worry over the habitual quantity of urine in a chronic condition, because if there is real retention of fluid or poison in the system, it must in a short time accumulate so as to be perfectly evident; and if, on the other hand, the kidney is performing its function according to a modified plan that fulfills its purpose, interference is unwarranted. While no one has been more assiduous than I in demanding frequent analyses and constant observation of kidney conditions in arteriosclerosis, yet dependence has been principally on the few-protein diet, exercise and intestinal treatment.

I do not know that many appreciate the diuretic value of exercise. Often enough, when through careful bed treatment, after a very long period of time improvement has come to a standstill, further progress is not obtained until exercise begins; then the function of the kidney takes on new life and improvement is rapid. Tentatively, but with more and more boldness, I have come to look upon walking as essential to the well-being of the kidney as to the lungs and heart.

Hydrotherapeutic measures, while they may reduce blood pressure temporarily, do not in the long-run produce a great deal of effect on this symptom. However, these things have a marked effect upon other symptoms, and improve in a great measure the patient's general condition. There is considerable advantage in all things which produce free sweating,

whether it be a Turkish bath—properly regulated, electric light baths, hot-air cabinet, friction, or, best of all, exercise.

In the treatment of hypertension, laxatives are the one thing which we cannot dispense with until such time as the bowels have been regulated by the diet. For many years a morning saline purge has been the routine practice in the management of contracted kidney. In hypertension due to intestinal toxæmia this has a theoretical objection in the possibility of rendering the intestinal tract alkaline or upsetting the osmotic function and so favouring absorption. Certain it is that I have seen a number of persons with hypertension who have been distinctly damaged by the abuse of mineral waters at health resorts. I am not prepared to say that this applies to all salines used in various ways, but I prefer to be on the safe side and use, as a routine measure, laxatives to which there is no such objection.

I believe castor oil as an occasional laxative is better than any other, and that aloin, in one of its numerous combinations, is a safe laxative, though the use of calomel and blue mass have served a good purpose when given every week or ten days in these chronic ailments.

When blood pressure is exceedingly high the nitrites may be used. To return to the author's own experience, he saw so much harm in the earlier days of his practice from the administration of nitrites to reduce blood pressure, as such, that he is always exceedingly cautious in ordering nitrites on the ground of mere blood pressure altitude. However, if in moderation they render the patient more comfortable, they may be used in such circumstances as appeal to the judgment of the physician in charge. If there is reason to believe that there exists vascular spasm, as in anginal attacks in any part of the circulatory system, the nitrites are urgently demanded and fulfil their most beneficial function.

When it is observed, as often happens, that the nitrites improve symptoms, without reduction of blood pressure, it may be concluded that we have to deal with the most advantageous occasion for the use of nitrites, because it indicates that undue spasm has been relieved in some part

of the circulatory channel. Occasionally the same thing happens with a moderate reduction of, say, twenty points in blood pressure, but ordinarily this can be traced to other causes than the drug. When nitroglycerin in cardiovascular disease actually reduces blood pressure to a very marked degree, there is ordinarily an increase of symptoms referred to the heart and brain. In the hypertension of Bright's disease, in which condition the nitrites were formerly used to excess, the man is much better without the nitrites, except in emergencies. He should learn the use of nitrites in emergencies, because there is no drug so apt to do good and so little apt to do harm when given in a single dose; but as a rule it should be reserved for emergencies. In suffocative attacks, in angina pectoris, in threatened apoplexy, in sudden dyspnœa, and indeed in almost any emergency, a small dose of nitroglycerine is a safe and most efficacious remedy, but it should never be used for the unintelligent reduction of blood pressure, which often enough is the ultimate result of a compensatory process.

The observation of a large number of blood pressures has led me to place 200 millimetres of mercury as approaching a dividing line between compensatory pressures and pressures requiring attention. I can recount quite a number of persons who presented themselves with tensions of 210, 220, 230, 240, 250, and even 260, who, on a suitable regimen and general management, fell a little below the 200 mark, and continued at this point for long periods of time. Such persons surely should not be overdosed with nitrites.

However, in every movement of the nature of a reform movement (and that may be well applied to the introduction of conservatism in the use of nitrites), there is danger of our going too far, and it is doubtful whether any generation ever remains in exactly the medium position midway between abuse and neglect.

The element of diet is really the important one in hypertension. So long as there is something circulating in the blood that nature wishes to throw off, it will attempt to do so by creating hypertension. These are the instances in

which the nitrites will counteract the functional increase in blood pressure.

When the pressure is due to organic changes in the blood vessels, nitrites do not reduce pressure to any extent. Indeed, the administration of a dose of nitroglycerin and the observation of its effect serves as a test between the hypertension of which Russell has so brilliantly written and the hardened arteries which were the supposed foundation of high blood pressure according to the older pathologists.

In the treatment of hypertension as a clinical symptom, it is well to revert to some of the considerations of the period before the universal use of the sphygmomanometer. Everyone has had the experience, when a person comes under treatment, of examining the pulse and feeling what seems to be a great improvement because the artery feels soft and natural, and yet the sphygmomanometer when applied shows the measurement just as high as before when the pulse was entirely different. This softening of the pulse by treatment, which for ages has been recognized as following the use of an efficient laxative, rest, or indeed, the removal of any cause of irritation from the circulation, is a restoration of the normal that is clinically very well worth while; and though it does not mean a lowering of blood pressure, as is proved by the accurate measurement, it does mean that the sufferer is really in better condition.

A typical result of the persistence in a proper treatment after the preliminary "course of treatment" was that of Mrs. A. B., referred to me by Dr. V. A. Robertson, of Brooklyn. She was sixty-three years of age, five feet one inch tall, and weighed 190 pounds. Her father had lived to the age of eighty-seven and had died of cystitis. Her mother had died at exactly her age of angina pectoris. She was born in Scotland. She had two brothers and one sister living.

She had not slept well for a long time. She had passed the menopause without symptoms, and had never had any severe illness. She complained of troublesome breathing on exertion; severe headaches; præcordial discomfort; and a knowledge that she had a high blood pressure. These

symptoms had developed subsequent to an exhausting anxiety in the treatment of her sister during an attack of typhoid fever.

On examination there was a faint, blowing systolic murmur; some thickening of the radial artery; præcordial tenderness; and a blood pressure of 190 mm. Hg.

She was treated by modified Nauheim baths, a few-protein diet, and when she had sufficiently improved was ordered to take systematic out-of-door exercise. This she has continued for the past several years.

A recent examination for the purposes of this book showed that she had had no return of symptoms; her blood pressure had fallen to 155 mm. Hg; hæmoglobin being 100 per cent.; weight, 195. She said she had never felt better in her life, and was able to walk long distances.

The fear is often expressed by people that, in the absence of a multiplicity of proteins, the foods replacing them will cause great increase of weight. As a matter of fact this does not happen, as illustrated in this instance by the fact that the woman's daughter weighed more than she did, great weight being a family characteristic.

It cannot be emphasized too often that persons on a strict diet should be under supervision. If there is any deterioration of condition, or the hæmoglobin percentage tends to fall, or there is a loss of weight, the situation should be carefully reviewed.

With very sick patients, the urine should be watched for acetone and sugar.

It is surprising how little trouble any of those on this diet have from starch indigestion or flatulence.

While on nearly every page of this book exercise has been spoken of as of prime importance in the prevention and treatment of arteriosclerosis, nevertheless, it cannot be emphasized too much, and specific instructions are worth the space they will occupy.

Walking is the most available and generally satisfactory exercise. My old family physician, who is now retired and spending the winter in Nassau, no doubt enjoying the freedom

of speech that is not always wise to the man in practice, says that we doctors prescribe what agrees with ourselves, and that is all there is to it. There is some truth in this, though perhaps it is not wise to put it in print.

To yield just once to this tendency will do no harm, so for the moment let us look at the merits of fencing as a form of exercise available to all ages. As a matter of personal experience, writing and working so much on the prolongation of efficiency led me to realize that some form of exercise was necessary if I was not to be a victim of the disease of which I had made a specialty.

A very little observation showed me that some of the best men in the profession employed fencing as a means to the maintenance of health, combined with recreation. I soon found that there were many men keeping themselves in fine physical condition in this way, and that not a few of them had taken up the exercise after forty. Some had never fenced before the age of fifty. At the present time, at the Fencers' Club in a neighbouring street, I often meet Dr. Carrell, who has lately won world-wide fame for his work on the blood vessels, and many other distinguished men of our profession. It is not an infrequent experience when I go for my afternoon bout to find that more than half of those fencing are physicians in active practice. In this instance it cannot be said that the doctors do not take their own medicine.

As an exercise, fencing has many advantages, particularly to the busy worker. A satisfactory amount of exercise, including a bath, can be obtained within an hour. Fencing exercises all the muscles without straining any of them. It also steadies the nerves, quickens the eye, and trains the temper.

I have examined a number of old fencers whose years would entitle them to atheroma, and find it remarkably slow in coming.

In considering exercise, many authors fall into the error of regarding a single lesion instead of a whole disease. They think only of the failing heart muscle, and hold up their hands in horror at the mention of physical labour.

On the other hand, I can testify from an experience of years devoted exclusively to ministering to the needs of people sent me mostly from other physicians to be treated for cardiovascular disease, that there is no measure I would less willingly dispense with for the permanent correction of arteriosclerosis.

The circulation is dependent upon a proper accomplishment of the functions of the lungs, stomach, intestines, liver and kidneys. What is the best stimulant to the lungs? Exercise. What most promotes the tone of the digestive organs? Exercise. What best overcomes a torpid liver? Exercise. What is the best diuretic? Exercise.

Degeneration is more to be feared than strain after a reasonable period of rest, and with a person taught to respect his breathing and avoid exhaustion and strain, a change to out-of-door life is much more often indicated than many believe before it has been tried. I have seen old people with ominous recurrences of suffocative œdema who recovered when the daily outing was instituted.

"Regeneration *versus* Degeneration" might be the heading of this chapter of medical experience. If anyone doubts it, let him try a little at first and then more as he becomes bolder. Ask my friend Dr. B. how his brother has done these last ten years on enforced exercise since his attack of hemiplegia and aphasia complicated with cardiac dilatation. And yet the good doctor greeted me for many years with the warning, "You are killing F.," "You are killing F." But F. is still being killed, and the doctor himself is suffering from the strain of a too great practice, the worries of which were not balanced by exercise.

In quite a number of persons suffering from arteriosclerosis, it is evident that the abdominal vessels are taking more than their proportionate part in the process. This seems to be particularly true in those with very high blood pressures, who complain of severe discomfort in the epigastrium.

An example of this condition was a lady, Mrs. H., referred to me by Dr. M. M. Slocum, of Far Rockaway. She gave a

history dating back to an attack of acute nephritis eight years before. She was fifty-eight years of age. Her father died at eighty-five; her mother, at sixty-three. She had eight sisters and brothers, four of whom were living. She was short and stout, weighing 164 pounds. She had previously been well, and had several healthy children.

Mrs. H. was in great distress on account of choking attacks with dyspnœa that occurred in the early hours of the morning, and awakened her from sleep. She dated her trouble from an attack of so-called kidney disease eight years before. She had been growing more and more uncomfortable on account of a feeling of fullness in the head, attacks of palpitation, dizziness, headache and epigastric distress. All these conditions were accompanied by a feeling of intense nervousness. The systolic blood pressure was 230 mm. Hg; and the heart sounds showed a moderate degree of dilatation, with a double aortic and a faint mitral systolic murmur. There were some moist râles at the bases of both lungs—the most marked were in the left.

Mrs. H. was ordered to bed, as it was very evident that her condition was not such as to warrant her being about, and she was directed to take an immediate full dose of castor oil, and to limit her diet to cereals, bread and butter and cheese. During the next few days her condition gradually became worse, her blood pressure rising to a point where it was difficult to measure—over 260 mm. Hg with the "Tycos" sphygmomanometer, and the distress in her epigastrium and head became very intense, with a more or less constant dyspnœa. Mrs. H. declared that she was threatened with a rupture of something inside of her head.

In this emergency, I decided upon a phlebotomy, and with the help of Dr. Joseph B. Bissell took a quart of blood from her right arm. The symptomatic relief of this procedure was very striking. The pain in the head was almost relieved, the epigastric discomfort was removed, and a hard tense resistance was replaced by a softness and pliability of this region that was remarkable.

From this time on, she was kept on a very strict diet,

the use of salines was prohibited and castor oil was used in their place. Out-of-door exercise was enforced, though the opposition to this was so great that it had to be compelled by the utmost persuasion. However, she soon recognized the benefit of the regimen, and the distaste for exercise gradually decreased until she got to walk several miles out of doors every day.

The systolic blood pressure when in her average condition measured 200 mm. Hg.

She has continued her regimen ever since, and at the present writing is able to keep herself fairly comfortable by a continuation of the few-protein diet, the use of castor oil and outdoor exercise.

The urine was usually of fair specific gravity, with a faint trace of albumin, extremely marked reaction for indican a good deal of the time, and always contained hyaline, granular casts.

Of course the most serious symptoms when Mrs. H. first came under observation were the attacks of œdema of the lungs that occurred in the early morning hours, and this had led to an absolutely serious prognosis on the part of previous medical counsel. These have never recurred, nor has there been any reason for repetition of phlebotomy.

The enforcement of outdoor exercise in very high blood pressure of this type, namely, that in which the sclerosis of the abdominal vessels is believed to be of unusual development, seems to have been justified by the apparently brilliant results, not only in this patient, but in several others, particularly women.

I have found a preliminary phlebotomy necessary before the regimen could be safely inaugurated in these severe pressures.

Venesection is a procedure that is not used with nearly enough frequency. There is a possibility that, in addition to other elements of value, it reduces the tension of toxins in the blood. If we suppose the existence of substances, whatever their origin, that the kidneys are unable to eliminate or the tissues destroy, and we remove 5 per cent. of the

whole blood, the bulk of the blood is entirely restored, but the saturation of the blood by the particular toxin is reduced to 95 per cent. of what it was, and short of saturation this toxin may not be nearly so harmful.

The same thing is an argument for eliminative measures which act through the skin and the mucous membranes, though we know that the eliminations through these channels of the grosser waste products is very slight.

Mild insomnia may be controlled by warm baths or packs and hot drinks. Trional, sulphonal and the bromides are effectual in others. The more severely disturbed will require more positive hypnotics, such as chloral in moderate doses, at times. Marked psychic symptoms can often be cared for best in hospitals. When such people can be induced to remain in bed, the rest treatment will be found beneficial, appropriate massage taking the place of exercise.

Some unfortunate individuals have engrafted upon their arteriosclerosis a complicating true rheumatic infection, and other persons suffering from rheumatism develop arteriosclerosis. These two serious diseases run along side by side and more or less mask each other.

In general the heart trouble of rheumatism affects mostly the mitral valve, while the lesions of arteriosclerosis involve the aortic valve. In all examples of both diseases, as time goes on, there is a tendency toward a common type. The rheumatic picture becomes arterialized and the arteriosclerotic condition becomes mitralized. In these rheumatic-arterial subjects it is particularly important to avoid the possible recurrent attacks of rheumatic inflammation. If they show a tendency year after year to a spring attack of rheumatism, some very serious effort ought to be made to obviate this by a change of climate. A crippled circulatory system is poorly equipped to withstand the acute rheumatic influence.

IX

DIET IN ARTERIOSCLEROSIS

In no condition is diet of greater importance than in arteriosclerosis, but at the same time those suffering from this disease constitute a most difficult class of persons to control. Food habits are of long standing, and many have arrived at the time of life when the pleasures of the table are an important element in enjoyment of life.

Another difficulty is, that when particular foods have acted as poisons for a long time, they constitute habits analogous to drug habits. Most poisons act as stimulants at the same time that they are causing damage.

In a special chapter will be found the author's plan of diet and the reasons for it, but there are certain generally accepted topics that need to be reviewed for a clear understanding of diet in arteriosclerosis.

The problem that confronts us in the care of cardiovascular disease reduces itself in a great measure to regulation of the amount of protein food, while, at the same time, supplying the needs of the body. It is easy enough for a few days when a person is acutely ill to feed him on a single article of diet which excludes some particular element, but for anyone who considers himself well and is warding off illness by a special regimen, or for a long illness, that will not do.

For regulation of food, we must fall back upon the information that is given us by chemists. In doing this, we are only following the lead of what has been done in many other departments of life. Agriculture is now conducted on a chemical basis, with the result of doubling the

efficiency of farms; animals are fed according to chemical principles, with the result of great profit; in the arts and manufactures, chemistry has absolutely revolutionized the procedures of former years. The achievements of chemistry read like a fairy story. How foolish it is, therefore, to disregard the teachings of chemistry in our own bodies, which are nothing in the world but complicated laboratories!

While protein food is harmful in excess, it is also necessary in moderation. It is found, however, that a healthy person does not need more than 90 grams of protein food in a day; and that he can get along fairly well if he does not go below 50. Protein is very important in building up the tissues, strengthening the muscles, and stimulating the activity of the brain and the emotions. It is the food that produces great leaders and brain-workers, but it is also a food that, in the present day, is terminating prematurely some of the best lives in the nation.

For all these reasons, when, on account of threatened danger to various organs, protein is reduced, the power of the food to produce heat, energy and so forth by other means must be considered. Chemists have measured the property of food with respect to its production of heat and energy and have measured it in terms of calories, and it is found that the average person needs 2000 calories or more. So we have somewhat of a puzzle to supply the necessary calories without exceeding the protein allowance.

When we come to examine food, we find that it is easily divided into two classes: the class in which cereal is most abundant, and the class in which protein is most abundant.

In devising a diet for arteriosclerosis and kidney degeneration, we may accomplish a good deal by the simple method of reducing the quantity of food as a whole, without paying much attention to its quality.

When the kidneys are healthy and competent and there is no chemical reason in the intestinal tract for diminishing proteins, an ordinary mixed diet, in proper quantities, is all

that is required. Indeed, there are certain instances when protein may be increased provided it is properly chosen.

The carbohydrates are necessary in the long-run because they principally supply the carbon which is constantly being given off by the lungs in the form of carbon dioxide. If the carbohydrates are not supplied, exhaustion soon ensues.

The matter of fluids is an important one. Indeed, I have often seen the circulation markedly improved by the simple withdrawal of an excess of fluid. A healthy person soon eliminates an excess taken into the body, but that is not true in disease. The overloading of the system with water puts an extra burden upon the heart and leads to very serious results; this is particularly true in broken compensation.

In acute conditions, the simplest and best diet to begin with is a milk diet, but that must very soon be supplemented by other nutritious foods.

In arteriosclerosis, the quantity of food should be reduced to what is necessary for the maintenance of the bodily weight and strength. The food should be divided into five small meals, the largest meal being taken in the middle of the day. The food should also be as dry as possible.

In considering a specific choice of diet, we must divide people sharply into two classes. There are those in whom, on account of a lesion of the heart of a mechanical nature, the welfare of the person depends upon the maintenance of a healthy heart muscle, able to do an extra amount of work. In these the problem is the same as that presented by tuberculosis or any other condition where the maintenance of health depends upon the maintenance of resistance. In these, diet must be reasonable, but there is no necessity for careful chemical supervision.

In the second class, the one that we wish to consider, are the people suffering with general cardiovascular disease, of chemical, or at least toxic, origin.

There are other reasons for a close consideration of protein food. Protein substances have a great deal to do with intestinal putrefaction, which itself is a serious question

in arteriosclerosis. Also the kidneys, when diseased, have difficulty in dealing with protein substances.

On the other hand, protein food is that which gives strength of will and energy of mind, and it also gives tone to the organs of the body.

The other foods supply fuel to keep the body warm and the machinery running, but do not improve the resistance of the body in its constant warfare against disease and degeneration. Illustrations of this fact are found throughout medicine, from the youngest, where the condensed-milk-fed baby, though fat and handsome to look upon, easily succumbs to disease, to the old person with Bright's disease, existing on a milk diet but losing energy from day to day.

It was a good expression of this fact that I saw in a newspaper the other day, in connection with a prominent man who had dropped dead. It was said that the man had died because he had "subsisted on a wrong ration."

Just as surely as an automobile engine will stop or run badly if the mixture in the carburettor is wrong, so surely will a human being drift into disease and perhaps perish if his food supply is not properly balanced, with regard to his condition and the demands upon him.

The principles to be remembered are: that an adult requires from 14 to 20 calories to each pound, according to the amount of work he does. The weight is to be estimated by the normal weight of the height of the individual—for instance, a person five feet seven inches tall ought to weigh 150 pounds. At light work, he would require an average number of heat units per pound—seventeen, or 2550 calories. If a healthy man has more than this, he will accumulate fat; if he has less, he will run down.

The average man must have, at least, fifty grams of protein food, at moderate work, or else he will degenerate in will, and the integrity of his organs will be undermined. If we could neglect the protein element, all that a person would have to do, in order to get enough heat units, would be to eat a large quantity of food. However, to keep the protein content of the food right and yet supply enough heat units,

requires a modification of diet analogous to feeding a child with modified milk.

Carrying firmly in mind the protein question and the heat-unit question in the presence of arteriosclerosis, we limit the protein content to fifty grams, using tables of analyses of foods.

Roughly speaking, but with sufficient accuracy for practical purposes, an average helping of meat contains twenty-five grammes of protein, or, to be more accurate, a cubic inch of beefsteak, beef or fish, contains eight grams; an egg contains eight grams, as does also a glass of milk. An ordinary helping of rice, potatoes, bread, or hominy contains about four grammes of protein. Thick cream, butter, or oil contain no protein practically and are very rich in heat units. Green vegetables do not count one way or the other.

The number of heat elements in the average helping of food is not so easy to remember, because it varies more or less, but, aside from the tables, you can count on getting about 500 heat units with the purely protein elements of food, such as meat, eggs, oysters, and so on, and you can count on getting about 150 heat units in each average helping of purely cereal food.

A very clever older physician said to me not long ago that advances in medicine consisted, in a great measure, in finding new reasons for doing old things, though he acknowledged that the old things were done much better with the new reasons. So it will be found that one helping of meat a day and one egg for breakfast, and a single helping of the other forms of food that are offered, with plenty of butter and cream, will not figure out far wrong from theoretic requirements.

In cardiovascular disease milk sugar is a very valuable addition to diet for many reasons.

A sufficiency of calories can be judged by watching the weight. If the weight is maintained, the heat supply is certainly sufficient.

It is not so easy to judge of the sufficiency of protein supply. It is so hard to tell whether a deterioration of con-

dition is due to protein starvation or to the disease. However, if the person is suffering from serious hardening of the arteries and kidneys, with heart trouble, and is getting fifty grammes or more of protein a day, the chances are that the deterioration is due to the disease and not to protein starvation.

A great trouble in chemical regulation of diet is the confusion of ordinary and technical measures. However much the metric system may be valued by chemists, it has never become an integral part of Anglo-Saxon knowledge, so common measures must be used.

A simple diet, handed to me by a gentleman with advanced arteriosclerosis for mathematical analysis, and which figured out about right, was as follows:—

JANUARY 20.

	Calories.	Protein.
Luncheon—		
1 cup of bouillon	40	10
2 slices of mushroom on toast	50	2
1 tablespoon of potatoes	100	2
1 plate of endive and lettuce salad	125 (oil)	...
1 saucer of rhubarb	...	...
1 piece of gingerbread	230	4
Dinner—		
1 plate of vegetable soup	50	3
3 tablespoons of stewed tomatoes	...	...
1 large tablespoon potatoes	110	2
2 large tablespoons of beans	60	4
2 tablespoons of Indian pudding	175	8
Lactose with each meal	300	...
Average breakfast	315	8
Total for day	1555	43

JANUARY 21.

Breakfast—		
1 orange	40	...
1 small bowl of wheat berries	160	4
2 slices of toast	115	4
1 cup of weak coffee	...	...
Luncheon—		
4 large fried scallops	60	8
2 tablespoons of chopped potatoes	220	4
1 plate of cabbage and lettuce salad	125 (oil)	...
2 tablespoons of preserved peaches	40	...
1 cup of weak tea	...	..

Dinner—	Calories.	Protein.
1 plate of vegetable soup	50	3
3 small slices of bread	230	8
2 tablespoons of potatoes	220	4
2 ,, ,, spinach	...	...
1 plate of scallop and lettuce salad	140	4
1 small piece of pumpkin pie	250	4
1 small piece of cheese	120	8
Lactose with each meal	300	...
Total for day	2070	51

JANUARY 22.

Breakfast—		
Practically as before	315	8
Dinner—		
1 plate of vermicelli soup	120	4
4 small potatoes	200	4
2 tablespoons of gravy	...	...
3 stewed onions	100	4
Ice cream	320	8
3 small slices of bread	230	8
Cake	230	4
Tea—		
1 cup of bouillon	40	10
1 tablespoon of fried potatoes	110	2
3 slices of bread	238	8
1 plate of lettuce and celery salad	125 (oil)	...
1 cup of weak tea	...	...
Ice cream	320	8
Sponge cake	230	4
Lactose with each meal	300	...
Total for day	2878	72

JANUARY 23.

Breakfast—		
As before	315	8
Luncheon—		
3 tablespoons of macaroni	100	3
2 ,, ,, spinach	...	...
3 small slices of bread	230	8
1 plate of lettuce and endive salad	125 (oil)	...
1 piece of pumpkin pie	250	4
2 pieces of cheese	120	8
1 cup of weak tea	...	...
Dinner—		
Large plate of farina soup	50	2
3 tablespoons of macaroni	100	3
2 ,, ,, potatoes	220	4

Dinner (continued)—	Calories.	Protein.
3 pieces of preserved peaches	40	...
3 slices of bread	230	8
Lactose with each meal	300	...
Total for day	2080	48

JANUARY 24.

Breakfast—		
As before	315	8
Luncheon—		
1 plate of lettuce and endive salad	125 (oil)	...
2 tablespoons of potatoes	220	4
2 ,, ,, fried hominy	120	4
3 pieces of preserved peaches	40	...
1 cup of weak tea	...	...
Dinner—		
Large plate of vegetable soup	50	3
2 tablespoons of boiled potatoes	180	4
2 ,, ,, stewed peas	100	7
2 ,, ,, rice pudding	175	4
Lactose with each meal	300	...
Total for day	1625	34

N.B.—One glass Sauterne with each luncheon. Average for five days: protein, 49; calories, 2040.

At this time, I added a single portion of meat, equivalent to a single chop each day. The prescription of a diet is like the writing of a prescription for an individual—however many prescriptions for other people you may have at hand to copy, there is always something individual that suggests itself.

It is needless to remark that the above is an illustration of quantitative protein feeding in a person in whom for special reasons it was not thought advisable to apply the author's qualitative method, the few-protein diet.

In the treatment of arteriosclerosis, one has to make a definite choice between the exercise cure and protective therapy.

One can withdraw from a person with arteriosclerosis one strain after another and so protect the person from danger, but the ultimate outcome can be nothing but increased invalidism.

On the other hand, according to my own experience, by

urging exercise and allowing the full quantitative supply of food with a careful qualitative regulation, there comes about an increased power of resistance and a decreased invalidism.

In America, perhaps, the best-known exponents of diet are those connected with the Battle Creek Sanatorium. My friend, Dr. J. H. Kellogg, has kindly sent me the daily menu showing the nature of the average meals served. From some of the literature obtained from the Sanatorium I have made the following notes, which cannot fail to be of interest to students of diet. In actual practice, the diet comes pretty close to the author's idea of a satisfactory few-protein diet.

"Experimental researches which support and confirm the claims we make for the Battle Creek Diet System have also been made by a number of other distinguished savants, among whom we may name especially Pasteur, Combe, von Noorden, Eck, Pawlow, Bienstock, Baumann, Mester, Schiff, Senator, Rubner, Hoppe-Seyler, Grawitz, and many others.

"Vegetable proteins are substituted for animal proteins. The reasons for this, briefly stated, are:—

"(1) Vegetable protein foods are free from toxins with which flesh foods abound. In flesh foods there are considerable quantities of these toxins which may be ingested without apparent injury for a long time, but the person whose constitution is broken down, whose liver, kidneys and other vital organs are so seriously crippled that they are scarcely able to remove from the blood the poisons which constantly and naturally originate in the body itself, cannot do the extra work of dealing with the toxic substances constantly found in meats, and in considerable quantities, without lessening the chances of recovery and, perhaps, promoting the progress of the disease.

"(2) Vegetable proteins less readily undergo putrefactive changes in the intestine, hence are less likely to become a source of poisoning to the body. This is a matter of great importance, as the researches of Metchnikoff, Tissier and others have shown that most chronic diseases may be directly traced to putrefactive processes in the intestine and the absorption into the blood of poisons thus formed, or intestinal auto-intoxication.

"(3) Vegetable proteins as found in natural food-stuffs are presented in a properly arranged bill of fare in the right proportions to supply the body needs, whereas proteins in the form of meats are in a highly concentrated form, and hence likely to be taken in great excess, giving rise to the enormous mischiefs which follow very high protein foods, as pointed out by Chittenden and Mendel, of Yale, and others in recent years.

"The high-protein diet of the American people, as has been pointed out by Professor Chittenden, is largely responsible for a world of mischief, the real cause of which has not been generally understood or even suspected until recently. Professor Chittenden has shown that by reducing the protein to the actual needs of the body,—that is, cutting out meats and, to a large extent, eggs, and making the protein only sufficient in quantity to serve for necessary repairs,—the endurance may be enormously increased.

"Thousands of men and women are living and working so far below the level of their maximum efficiency that they are quite unable to recognize the fact that every modification in quantity or quality of food shows itself in corresponding modifications of energy output.

"A man whose head is always dull, whose mind is confused all the time, who is constantly oppressed with a sense of languor, dread of effort, and inability to concentrate his mental or physical energies upon his business tasks or problems, has no opportunity to detect the fact that the miseries which he endures are directly attributable to the superfluous tenderloin steaks and various hard-to-digest or unnecessary food-stuffs swallowed at his daily meals. He is wretched all the time, and hence does not recognize the causes which are making him miserable.

"The revolution which may be wrought in such a person by a simple change in diet is so prompt and so wonderful as to be almost beyond belief."

The menu of a meal at the Battle Creek Sanatorium is interesting, and the composition of most of the dishes, though bearing special names, may be inferred.

Dinner.	Pro.	Fats.	Carbo.	Oz.	Portion.
Soups—					
Cream of browned onion soup	15	98	37	4¾	1½
Navy bean soup	25	10	65	4¾	1
Entrees—					
Braised protose	52	48	24	4	1¼
Baked Nuttolene	25	53	22	2	1
Marconi au gratin	30	45	50	2¾	1¼
Vegetables—					
Baked potatoes	11	1	88	3	1
Brown cream gravy	18	76	31	2¼	1¼
Mashed potatoes	9	25	66	3¼	1
Creamed parsnip	7	16	52	3	...
Breaded tomatoes	5	17	28	3½	½
Relishes—					
Lettuce—lemon	2	1	7	1¼	1/10
Yogurt cheese salad	20	175	5	1½	2
Fruit macedoine	2	3	45	3	½
Malt honey	0	0	200	2½	2
Malt honey with butter	0	100	100	1½	2
Malt sugar	3	16	81	⅞	1
Breads—					
Whole wheat bread—1 slice	12	2	61	1	¾
White bread—1 slice	9	4	62	1	¾
Entire Graham bread—1 slice	10	4	61	1	¾
Breakfast toast—2 pieces	4	12	34	½	½
Toasted granose (wheat) biscuit—2	7	1	42	½	½
Toasted rice biscuit—2	4	0	46	½	½
Good health biscuit	4	2	44	½	½
Bran biscuit—2	21	31	73	1	1¼
Nut butter	28	105	17	1	1½
Dairy butter—1 square	1	99	0	½	1
Cooked fruits—					
Cranberry sauce	1	2	147	3	1½
Stewed figs	6	1	143	3	1½
Beverages—					
Apple juice	0	0	50	2¾	½
Grape juice	4	2	44	4	½
Milk	23	67	35	6	1½
Yogurt buttermilk	28	5	42	6	¾
Sanitas cocoa	13	89	23	5	1¼
Hot malted nuts	36	96	68	1¼	2
Minute brew—1 teacupful	1	1	8	4	1/10
Sugar—1 sugarspoonful	0	0	25	⅛	¼
Cream—1 pitcherful	6	107	12	2½	1½
Kaffir tea	1	1	8	4	1/10
Dessert—					
Queen of puddings	26	72	102	3½	2
Tangerines	5	2	68	6	¾
Brazil nuts	9	87	4	½	1

To ascertain the number of calories eaten of each element, add the figures in first, second and third columns opposite the various articles eaten, and put down the sums at the foot of the respective columns. Mark each article eaten, sign bill of fare, and hand to your physician.

A "portion" is that quantity of any food which contains 100 calories or food units.

So much has been said in this book as to cheese as a safe form of protein, that the remainder of this chapter will be devoted to extracts from the U.S. Department of Agriculture, Bulletin No. 487, on this article of food.

"Although cheese has been a staple food with many races for uncounted years, there is a widespread belief that it is suitable for use chiefly in small quantities as an accessory to the diet, and that in large quantities it is likely to produce physiological disturbances. We are inclined, therefore, to think of those who make cheese one of the chief articles of their diet as being driven to this course by necessity rather than being led to it by choice.

"Because of these opinions, extensive studies have been carried on as a part of the Department of Nutrition Investigations of the food value, thoroughness of digestibility, ease of digestion, physiological effect and special character of cheese as food, as well as of methods which are followed in preparing it for the table. The conclusion drawn from this extended study is, in brief, that cheese properly prepared and used is not generally a cause of physiological disturbances, and that it may easily be introduced into the bill of fare in such quantities as to serve as the chief source of nitrogenous food, and may be made a substitute for other nitrogenous foods when such substitution is desired. The results of these studies have been brought together in this bulletin with a view to making them helpful to all interested in the subject, but particularly to housekeepers.

"From the standpoint of the housekeeper, cheese is of importance because of its high nutritive value, particularly its high percentage of protein or muscle-forming materials, because of the ease with which it can be kept and prepared for the table, and because of its appetizing flavour and of the great variety of ways in which it can be served.

"The average cheese while fresh and moist contains proteids and fat in much the same ratio as that in which they are found in the milk. More than one-fourth its weight is proteid, about one-third fats, and one-third water. There are always present small amounts of albumin and sugar

which have clung to the curd. Owing to the addition of salt, the percentage of mineral matter is high compared with that of most other foods.

"KINDS OF CHEESE USED IN AMERICAN HOMES.—The American factory cheese—the so-called American cream cheese—is of the English Cheddar type, and as it is the most commonly used of all the commercial varieties in the United States, may be taken as a standard. Other types are, however, well known, particularly in cities and large towns where there are well-stocked markets and stores, and it is interesting to note also, at least briefly, the characteristics of some of them. Full descriptions of a very large number of cheeses (about 250 in all) may be found in an earlier bulletin of this department.[1]

"*Cheddar and American Full-Cream Cheese.*—Cheddar cheese—named from the English village where it originated—is a comparatively old type of cheese, very popular in England and also in the United States. The name is now more fitly applied to a process than to any particular shape.

"Cheddar cheese is made from sweet cows' milk, which may be skimmed, partly skimmed, or unskimmed. If made from unskimmed milk, the cheese is called 'full-cream.' If cream is removed, the cheese is designated 'part-skim' or 'skim,' as the case may be.

"Cheese of Cheddar type as made in the United States is perhaps most often marketed in large, flat, round forms, 13 to 16 inches in diameter, about 5 or 6 inches in height, and weighing 26 to 32 pounds each, though other shapes and sizes are also fairly common. It is usually pale to darker yellow in colour, though it may be white when uncoloured. When fresh it is mild in flavour, but when well ripened has a characteristic and sharp taste. The new cheese is soft, though not waxy, in texture, and may be easily shaved or broken into small pieces. When well ripened it may be finely grated.

"These characteristics, together with its distinctive and peculiar flavour and its wide distribution in the markets, are

[1] *U.S. Dept. Agr. Bur. Anim. Indus.*, Bull. 146.

qualities which help to make it the variety most commonly used in the United States.

"*English Dairy Cheese.*—From the standpoint of the cook who frequently wishes to use grated cheese this variety is important. Though made in much the same way as Cheddar, it differs from it, in that the curd is heated to a somewhat higher temperature, and the cheese is therefore harder. It commonly sells for somewhat more per pound than the standard or American factory variety, and is likely to be found only in the larger markets.

"*Soft Cream Cheeses.*—Cream cheese true to name is made from rich cream thickened by souring or from sweet cream thickened with rennet. The whey is removed by draining. It is then covered, salted, and turned occasionally, being ready for market in five to ten days. A variety is also made with rennet from cream or low fat content, as well as a number of other special sorts much more common in France than in the United States.

"The term 'cream cheese,' however, is an elastic one, and includes many varieties which are sold under special trade names. Such cheese is common in most markets.

"Soft cream cheese differs from standard cheese, so far as composition is concerned, in having more water and fat and less protein, water usually making up about one-half of the total weight. It differs also in being much more perishable. These cheeses commonly sell for 10 or 15 cents each, which is about 40 to 50 cents a pound.

"Of late there have been on the market varieties of such cheese or of Neufchâtel, made by combining the cheese with chopped pimento. These bring a relatively high price in market and may be easily prepared at home if this seems more convenient.

"*Neufchâtel Cheese.*—This very popular variety—named from a town in north-eastern France—is similar in appearance and in the way it is marketed to soft cream cheese. It is made either from whole or skim milk curdled with rennet. After draining and pressing, it is kneaded thoroughly, formed into small rolls or blocks, and then ripened until specia

moulds develop, which requires about four weeks. It is then wrapped in tinfoil and marketed.

"*Parmesan Cheese.*—This is a name given outside of Italy to a very hard cheese which in that country is said to be known as 'Grana,' a name given because of the granular appearance which it has after it has been broken. It is sometimes sold in grated form and brings a relatively high price, but is more commonly sold ungrated. When well made it will keep for years and may be easily broken and grated. It is very generally used in Europe for serving with soups, for seasoning macaroni, and for other similar purposes, and is quite common in American markets.

"*Sap Sago.*—This is a skim-milk cheese made in Switzerland, which is suitable for grating. It contains, for every 4 pounds of cheese, 1 pound of a clover (*Melilotus cæruleus*) grown in Switzerland. It is greenish in colour and has an unusual flavour. It is not high-priced.

"*Gorgonzola and Roquefort.*—These are highly flavoured and characterized by the presence of moulds through their entire mass. Roquefort is made from the milk of sheep; Gorgonzola, from cows' milk.

"*Potted or Sandwich Cheeses.*—Ordinary cheese is often mixed with butter or oil in the proportion of 5 parts of cheese to 1 of butter or oil, by weight. The mixture is sometimes seasoned with mustard or with curry powder. Such cheeses, unseasoned or seasoned, are on the market in great variety. Potted cheese may be easily prepared at home if the housekeeper wishes to take the trouble.

"*Swiss Cheese* (*Emmentaler, Gruyère, etc.*).—This term as used in America is somewhat vague. Different names are given to the varieties according to the districts of Switzerland in which they are made, but they are all similar and characterized by a mild, sweetish flavour and the presence of large holes or 'eyes.' Foreign and domestic brands are to be found in most markets. They are suitable for cooking purposes, as well as for use without being cooked, and are much used in this way in Europe and well known and liked in the United States.

"*Edam Cheese.*—This is a cheese made in Holland. It is moulded in spherical form, and the outside is usually dyed red. It is usual in this country to cut off a section of the top, which serves as a lid, and to scoop out the inside as needed. In Holland it is frequently served in slices, particularly when it is fresh. Edam cheese is seldom used in cookery in American homes, though thrifty housewives, after the greater part of the cheese has been removed, often stuff the hollow shell with cooked and seasoned macaroni, rice or something similar, and bake.

"*Brie and Camembert Cheese.*—These are very soft rennet cheeses of foreign origin and of somewhat smaller nutritive value than standard cheese, and of strong flavour and odour. They are not often used in cookery, but are used as an accompaniment to other foods.

"*Cottage Cheese.*—Cottage cheese and other sour milk and cream cheeses, junket, Devonshire cream, and a number of other cheese-like products are described in the section which deals with home-made cheese.

"The Care of Cheese in the Home.—One of the best ways of keeping cheese which has been cut is to wrap it in a slightly damp cloth and then in paper, and to keep it in a cool place. To dampen the cloth, sprinkle it and then wring it. It should seem hardly damp to the touch. Paraffin paper may be used in place of the cloth. When cheese is put in a covered dish, the air should never be wholly excluded, for, if this is done, it moulds more readily.

"In some markets it is possible to buy the small whole cheeses. These may be satisfactorily kept by cutting a slice from the top, to serve as a cover, and removing the cheese as needed with a knife, a strong spoon, or a cheese scoop. It is possible to buy at the hardware stores knobs which, inserted in the layer cut from the top make it easy to handle. The cheese below the cover should be kept wrapped in a cloth.

"Cheese as a Food.—Cheese is used in general in two ways—in small quantities chiefly for its flavour, and in large quantities for its nutritive value as well as for its flavour.

Some varieties of cheese are used chiefly for the first purpose, others chiefly for the second. Those which are used chiefly for their flavour, many of which are high priced, contribute little to the food value of the diet, because of the small quantity used at a time. They have an important part to play, however, in making the diet attractive and palatable. The intelligent housekeeper thinks of them not as necessities, but as lying within what has been called "the region of choice." Having first satisfied herself that her family is receiving sufficient nourishment, she then, according to her means and ideas of an attractive diet, chooses among these foods and others which are to be considered luxuries.

"Those cheeses, on the other hand, which are suitable to be eaten in large quantities and which are comparatively low priced are important not only from the point of view of flavour, but also from the point of view of their nutritive value. Among such cheeses the one which, as noted above, is known to the trade as standard factory cheese and to the housewife as American cheese stands out pre-eminently. Therefore, when the word "cheese" is used without specification in the following pages, it may be taken to refer to this particular variety.

"The Flavour of Cheese.—Cheese owes its flavour to the fatty acids and their compounds which it contains and to ammonia-like bodies formed during ripening from the cleavage of the casein, to salt added to the curd, and in some varieties, like Roquefort, to bodies elaborated by moulds which develop in the cheese. In the highly flavoured sorts some of the fatty acids of a very marked odour are present in abundance, as are also the ammonia-like bodies. Indeed, in eating such cheese as Camembert a trace of ammonia flavour may often be plainly detected.

"The cleavage of the nitrogenous material of the cheese and other changes are brought about chiefly by the action of enzymes originally present in cheese or by micro-organisms, and are to be regarded as fermentative and not as putrefactive changes.

"The liking for highly flavoured cheeses of strong odour is a matter of individual preference, but from the chemist's standpoint there is no reason for the statement often made that such cheeses have undergone putrefactive decomposition.

"Composition of Cheese and some other Foods compared.—In the present state of our knowledge concerning dietetics it seems best to give the housekeeper general rather than absolute rules with respect to the kind and amount of food which should be eaten at any meal or at any given time by persons in normal health living under usual conditions. It is not necessary, therefore, for the housekeeper to know the exact composition of food materials in order to cater well for her family, a rough approximation being sufficient for the purpose. In the case of cheese she will be near enough to the fact if she thinks of it as composed approximately of equal parts by weight of proteids, fats and water. This rough conception is sufficient to associate it in her mind with the foods of high proteid value, a point which is important in connection with the making of bills of fare. It should lead her to class it also with the foods which are rich in fat, and prevent her from combining it unnecessarily with other fatty foods.

"In order, however, that the question of the use of cheese in the diet may be adequately discussed, knowledge of its composition in comparison with other foods is desirable, and there is an abundance of data available on this subject, since the composition of cheese and other foods has often been investigated at the Department of Agriculture, in experiment station laboratories, and in many other places where nutrition problems are studied. An extended summary of analyses of cheese of different sorts is included in an earlier publication of this department.[1]

"Data regarding the composition of cheese and a few other common foods are summarized in the following table:—

[1] *U.S. Dept. Agr. Bur. Anim. Indus.*, Bull. 146.

Average Composition of Cheese and some other common Foods as purchased, and also on the Basis of Edible Portion:—

Food Materials.	Refuse.	Water.	Protein.	Fat.
	Per cent.	Per cent.	Per cent.	Per cent.
Cheese	...	34·2	25·2	33·7
Beef of average composition as purchased	18·6	50·5	15·2	15·5
Edible portion	...	62·2	18·8	18·8
Porterhouse steak as purchased	12·7	52·4	19·1	17·9
Edible portion	...	60·0	21·9	20·4
Loin steak, broiled, edible portion	...	54·8	23·5	20·4
Dried beef	...	53·7	26·4	6·9
Eggs as purchased	11·2	65·5	13·1	9·3
Edible portion	...	73·7	13·4	10·5
Milk	...	87·0	3·3	4·0
Bread	...	35·3	9·2	1·3
Potatoes as purchased	20·0	62·6	1·8	0·1
Edible portion	...	78·3	2·2	0·1
Apples as purchased	25·0	63·6	0·3	0·3
Edible portion	...	84·6	0·4	0·5

Food Materials.	Carbo-hydrates.	Ash.	Fuel Value per Pound.
	Per cent.	Per cent.	Calories.
Cheese	2·4	3·8	1,950
Beef of average composition as purchased	...	0·7	935
Edible portion	...	0·9	1,145
Porterhouse steak as purchased	...	0·8	1,110
Edible portion	...	1·0	1,270
Loin steak, broiled, edible portion	...	1·2	1,300
Dried beef	...	8·9	790
Eggs as purchased	...	0·9	635
Edible portion	...	1·0	720
Milk	5·0	0·7	310
Bread	53·1	1·1	1,215
Potatoes as purchased	14·7	0·8	295
Edible portion	18·4	1·0	385
Apples as purchased	10·8	0·3	190
Edible portion	14·2	0·3	290

"It will be seen from the above table that cheese has nearly twice as much protein, weight for weight, as beef of average composition as purchased, and that its fuel value is more than twice as great. It contains over 25 per cent.

more protein than the same weight of porterhouse steak as purchased, and nearly twice as much fat.

"As shown by the figures in the above table, cheese contains 3·8 per cent. ash. Of this a considerable part may be salt added in cheese making. Like the milk from which it is made, cheese ash is characterized chiefly by the presence of calcium (lime), magnesium, phosphorus and iron, the average values being 1·24 per cent. calcium oxide, 0·049 per cent. magnesium oxide, 1·49 per cent. phosphorus pentoxide, and 0·0015 per cent. iron.

"The total amount of the mineral matter needed per day by the body is relatively small, yet mineral matter is very important. It is commonly assumed, and is probably true, that a mixed diet reasonably varied and reasonably generous will supply all the ash constituent which the body requires. If for any reason calcium and phosphorus are lacking in the diet, the amounts may be readily increased (as pointed out in one of the publications just cited) by a free use of milk and such milk products as cheese and junket without decreasing the palatability of the diet or materially increasing its cost.

"So far as its composition is concerned, then, cheese is entitled to be considered as directly comparable with meat. It is so used by the peasants of some parts of Europe, and was formerly so used among many other groups of people. The fact that it is not more commonly so used in this country is probably due to several causes. One cause is habit, which makes the meal seem incomplete unless it includes meat; another is the fact that, since cheese has a more pronounced flavour than meat, it is not so likely to be generally acceptable as the chief food of a meal. There is always likely to be at least one member of the family who does not relish it in quantity. Another cause is the fact that it is commonly believed to be indigestible, and still another is the fact that housekeepers, through lack of experience, are much less skilful in the arrangement of bills of fare in which cheese is the central food than they are in arranging bills of fare in which meat is thus used.

These last two causes will be considered in sections which follow.

"The Digestibility of Cheese.—As was stated above, cheese has been thought a cause of digestive disturbances, but work recently done by the Office of Experiment Stations, in co-operation with the Bureau of Animal Industry, tends to disprove this.

"In the large number of experiments which were conducted, young men in good health were fed on a diet consisting of bread and fruit combined with American factory cheese, which was made with different amounts of rennet and in different stages of ripening. The results showed that over 90 per cent. of the nitrogenous material of the cheese was digested—that is, retained in the body, and nearly 90 per cent. of the energy it supplied was available. In other words, cheese compares favourably with other foods in thoroughness of digestion—that is, in the percentage finally digested. Furthermore, it did not cause constipation or other physiological disturbances.

"The above statement refers to full-cream cheese. Experiments made at the same time gave practically the same values for the digestibility of skim-milk cheese, of Swiss cheese, of Roquefort and Camembert cheese, and of cottage cheese.

"Artificial digestion experiments made at the Minnesota Agricultural Experiment Station indicate that cheese protein is digested by the ferments of the intestines rather than by those of the stomach, and this is suggested as a reason for its reputation as a "hearty" food, the belief being that some foods which remain in the stomach longer than the average time, or are not digested by the stomach, are "hearty." Cheese protein (casein) is intimately associated with fat, and there is experimental evidence to show that this condition has an effect upon the progress of digestion in the stomach.

"The burning sensation or similar sensations sometimes experienced after eating certain sorts of cheese has been attributed to the presence of small amounts of free fatty

acids. It is commonly said that cheese is difficult to digest, the idea being that the body expends more labour in assimilating it than is required for other comparable foods. Experiments recently carried on by the Office of Experiment Stations, in which the respiration calorimeter was used to study the energy expenditure during the period of active digestion, do not indicate that cheese differs materially in ease of digestion from a comparable amount of meat. Uncooked full-cream cheese was used in these experiments. Another series recently begun by the Office of Experiment Stations with cooked cheese, though not yet sufficiently advanced to be conclusive, indicates that cheese thus eaten does not differ materially from raw cheese in this respect.

"In connection with the use of cooked cheese in the diet, one fact should always be kept in mind. This is that, in common with all other fatty foods, cheese which has been overheated in cooking is likely to contain burned—that is, decomposed—fats. Disturbances from this cause, however, should be laid to poor cooking and not to the composition of this special food.

"The use of potassium bicarbonate has often been recommended for increasing the digestibility of cheese, the amount suggested being a level teaspoonful to a pound of cheese. That the bicarbonate renders the cheese soluble in any appreciable degree, as has been claimed, is not apparent from a number of experiments which have been made. It does, however, neutralize some of the free fatty acids of the cheese, thus destroying some of the characteristic flavour. To some people this may be an advantage, but to others it would be counted a disadvantage.

"The Use of Cheese in the Diet.—It has been the purpose, in preparing this discussion of cheese, to consider ways in which mild-flavoured sorts may serve as staple articles of diet, rather than the use of highly flavoured varieties as appetizers and as accompaniments of other foods. The use of highly flavoured cheese as a condiment is customary and may profitably be extended, since

it offers a simple way of adding to the attractiveness of the diet. The variety of the cheese selected is a matter of choice, some persons preferring such kinds as well-ripened American full-cream cheese or the potted cheeses, and others such sorts as Roquefort, Camembert and other varieties. From the physiologist's standpoint, cheese used in this way for its flavour should really form a part of a well-balanced meal rather than be added to a meal which already supplies an abundance of nutritive material. In other words, condimental cheeses may better accompany a moderate than a very generous menu.

"In considering the use of cheese in quantity as an integral part of the diet, there are many possibilities, from simple combinations like bread and cheese to elaborate dishes in which cheese is used as a flavour and as a principal constituent.

"As has been pointed out, cheese, being rich in both protein and fat, would logically replace such foods as meat, fish and eggs when taken in quantity, rather than cereal foods characterized by a large amount of starch or succulent foods, such as vegetables and fruits. In planning menus of which cheese forms a large part the housekeeper should bear these facts in mind.

"Bill-of-Fare Making with Cheese as the Central Food.—Since meat has so generally been the chief protein food of a meal, and the kind selected usually has determined the choice of vegetables and condiments, it is not strange that very many housekeepers should be inexperienced and consequently unskilful in planning meals in which cheese is substituted for meat when for any reason they may desire to make such a change. In seeking skill they might take a suggestion from the experiments to which reference has been made, and also from a case investigated and reported by the Office of Experiment Stations, of a man who lived for months upon a diet of bread, cheese and fruit, and who remained in good health and active, and did not weary of the monotony of the diet.

"The first two articles of the diet mentioned, namely, the

bread and the cheese, could have been taken in such amounts as to constitute what is usually considered a balanced ration, *i.e.* in such amounts as to supply the right quantity of muscle-forming foods in comparison with the energy value. The bread and cheese taken with the fruit, however, make a ration which is well balanced not only in the older and more widely accepted sense, but also in the more modern sense that it makes an attractive and palatable combination of foods, as well as a balanced ration, and thus favours digestion. The watery and refreshing fruits or succulent vegetables with their large supply of cellulose are a pleasant contrast to the concentrated and fatty cheese.

"Housekeepers would probably find that if, in planning menus of which a cheese dish is the chief feature, they were to take pains to supply also crisp, watery vegetables, watercress, celery, lettuce served with a dressing or with salt alone, or simple fruit salads, and would give preference to refreshing fruits, either fresh or cooked, rather than to what are known as heavy desserts, they would in general be more successful in pleasing those who are served.

"There is another point also to be considered in combining cheese with other foods. Whether it is raw or cooked it is likely to be somewhat soft, and so seems to call for the harder kinds of bread—crusty rolls or biscuit, zwieback, toast, pulled bread, rye bread, the harder brown breads, or crackers, and some of the numerous crisp ready-to-eat cereal breakfast foods. Brittle cookies, too, seem more suitable than rich soft cakes or puddings for the dessert in such meals.

"A few bills of fare are given below which experience has shown to represent combinations of dishes which are palatable and which, if eaten in usual amounts, will supply protein and energy in proportions which accord with usual dietary standards. Menus such as these are more commonly served at lunch or at supper, but they might equally well be served for dinner, the selection of dishes for any meal being of course chiefly a matter of custom and convenience for those who have any range of choice.

Suggested Bills of Fare in which Cheese Dishes are the Chief Source of Protein and Fat :—

MENU No. 1.

Macaroni and cheese.
Raisin bread or date bread.
Orange and water-cress salad.
Baked apples.
Sugar cookies.
Cocoa.

MENU No. 2.

Cheese fondue.
Toast, zwieback, or thin and crisp baking powder biscuit.
Celery.
Potatoes, baked, boiled, or fried in deep fat.
Peas, or some other fresh vegetables.
Coffee.
Fruit salad with crisp cookies or meringues.

MENU No. 3.

Clear soup.
Baked eggs with cheese or Boston roast.
Baked potatoes.
Lettuce salad.
A sweet jelly, crab apple or quince, for example, or a preserve.
Rye bread.
Orange or banana shortcake.
Tea.

"These bills of fare should be taken as suggestive merely, and not as a solution of the problem. In fact, the whole art of making bills of fare needs developing. There is abundant evidence that overeating, where it exists, is frequently due to the fact that meals are not skilfully planned. People often continue eating after they have taken enough in total bulk, because they have not had all they want of some particular kind of food. The meal has contained too large a percentage of proteid or too much starch; has been too moist or too dry; too highly flavoured or not sufficiently flavoured. Bill-of-fare making calls not only for knowledge of food values, but also for skill in combining flavours and textures.

"In this discussion of menu making, and of the use of cheese as an integral part of the diet, the aim has been to suggest ways of using cheese to add to the palatability of meals made up of usual dishes, and to suggest dishes containing cheese which could serve as substitutes for meat dishes when so desired, and also for dishes of many sorts to be used as taste suggests, and in which the nutritive value as well as the flavour is increased by the addition of cheese. If cheese is used, and in quantity, it is obvious that some other proteid and fat foods should be diminished, in order that the meal or day's menu may not be unduly hearty.

"For the convenience of the housekeeper, a number of recipes for cheese dishes are given.

"CHEESE DISHES AND THEIR PREPARATION.—The list of cheese dishes in the culinary literature of this and other countries is a long one, but most of them are variations of a comparatively small number of general types. Those which have been selected and studied experimentally represent the principal types, and in many cases have been adapted to American methods of preparation and tastes. In some instances this has resulted in new and perhaps more rational combinations than those which served as models.

"For convenience, the cheese dishes included in this bulletin have been grouped under the following heads:—

(1) Cheese dishes which may serve as meat substitutes.
(2) Cheese soups and vegetables cooked with cheese.
(3) Cheese salads, sandwiches and similar dishes.
(4) Cheese pastry, cheese sweets and similar dishes.

"Variety may be obtained in the recipes by varying the flavourings. Among the best flavourings for cheese dishes are onion, chives and the ordinary green sweet pepper. Since the cheese needs very little cooking, however, and onion or the pepper needs a great deal, they should always be previously cooked, either by stewing in a very little water or by cooking in butter. The seeds of the pepper, of course, should be removed before cooking. Where chopped celery is used, as it may be in most of these dishes, it too should be cooked beforehand until tender. Other good flavours are mustard, curry powder, onion juice, chopped olives, pimento, and, according to European recipes, nutmeg or mace.

"In preparing the cheese it often has been found convenient to use a very coarse grater having slits instead of the usual rounded holes. Such a grater, in spite of its name, shaves the cheese instead of grating it. When the cheese is soft this is an advantage, since the grater does not become clogged.

"CHEESE DISHES WHICH MAY BE USED IN THE SAME WAY AS MEAT

"Meat is wholesome and relished by most persons, yet it is not essential to a well-balanced meal and there are many housekeepers who for one reason or another are interested in lessening the amount of meat which they provide or in substituting some other foods for it. The problem with the average family is undoubtedly more often the occasional substitution of other palatable dishes for the sake of variety, for reasons of economy, or for some other reason than the general replacement of meat dishes by other things.

"Foods which are to be served in place of meat should be rich in protein and fat and should also be savoury. Cheese naturally suggests itself as a substitute for meat, since it is rich in the same kinds of nutrients which meat supplies, is a staple food with which everyone is familiar, and is one which can be used in a great variety of ways. In substituting cheese for meat, especial pains should be taken to serve dishes which are relished by the members of the family. A number of recipes for dishes which contain cheese are given below. They are preceded by several recipes for cheese sauces which, as will appear, are called for in the preparation of some of the more substantial dishes.

"*Cheese Sauce No.* 1

1 cupful of milk.	1 ounce of cheese (¼ cupful of grated cheese).
2 tablespoonfuls of flour.	Salt and pepper.

"Thicken the milk with the flour and just before serving add the cheese, stirring until it is melted.

"This sauce is suitable for use in preparing creamed eggs or for pouring over toast, making a dish corresponding to ordinary milk toast, except for the presence of cheese. It may be seasoned with a little curry powder and poured over hard-boiled eggs.

"*Cheese Sauce No.* 2

"Same as cheese sauce No. 1, except that the cheese is increased from 1 to 2 ounces. This sauce is suitable for using with macaroni or rice, or for baking with crackers soaked in milk.

"*Cheese Sauce No* 3

"Same as cheese sauce No. 1, except that two cupfuls of grated cheese or 8 ounces are used. This may be used upon toast as a substitute for Welsh rabbit.

"*Cheese Sauce No.* 4

"Same as cheese sauce No. 2, save that two tablespoonfuls of melted butter are mixed with the flour before the latter is put into the milk. The sauce is therefore very rich in fat and has only a mild flavour of the cheese.

"Among the recipes for dishes which may be used like meat, the first thirty are such that, eaten in usual quantities, they will provide much the same kind and amount of nutritive material as the ordinary servings of meat dishes used at dinner. In several cases there is a resemblance in appearance and flavour to common meat dishes, which would doubtless be a point in their favour with many families.

"While, chiefly owing to custom, it may not accord with the taste of the family to serve cheese dishes at dinner in place of meat, it is much more in accord with usual dietary habits in American homes to serve such dishes at least occasionally for lunch, for supper, or for breakfast; that is, for a less formal meal than dinner. The last group of recipes in this section, beginning with "breakfast cereals with cheese," supply rather smaller proportions of nutritive materials than those in the first group and so may be more suitable for use at the less hearty meals. There is no hard-and-fast line to be drawn between the two groups, however, and many of the recipes may be used interchangeably.

"In the recipes calling for large amounts of cheese the food value is given, not in figures, but in comparison with beef of average composition and average percentage of waste.

This comparison is necessarily rough, owing to the varying composition of the foods and the varying weights of such ingredients as a cupful of grated cheese or bread crumbs. In making the comparisons, beef of average composition has been considered to have 15·2 per cent. of protein and a fuel value of 935 calories per pound; ordinary American cheese has been considered to have 26 per cent. of protein and a fuel value of 1965 calories per pound. After many weighings 4 ounces was decided to be the average weight of a cupful of cheese and 2½ ounces the average weight of a cupful of bread crumbs. These weights have been taken, therefore, in calculating the food value of dishes. When cheese is very soft, however, it may be pressed into a cup and measured like butter. Under these circumstances the weight of a cupful of cheese may be considered a ½ pound. The price of cheese is taken as 22 cents a pound, of butter 25 cents a pound, of eggs 25 cents a dozen, in this and all similar calculations in this bulletin. Prices vary with time, place and season. Those mentioned above are such as were paid for materials at the time the experiments here summarized were made and are not extreme values in either direction. Like all such estimates, the calculations are only relative, and the housekeeper who wishes to estimate the comparative cost of the cheese dishes and other foods can readily do so by taking into account the amount of materials used and the prices paid for ingredients at any particular time.

"*Cheese Fondue No.* 1 [1]

1⅓ cupfuls of soft, stale bread crumbs.	4 eggs.
6 ounces of cheese (1½ cupfuls of grated cheese or 1⅓ cupfuls of cheese grated fine or cut into small pieces).	1 cupful of hot water.
	½ teaspoonful of salt.

"Mix the water, bread crumbs, salt and cheese; add the yolks thoroughly beaten; into this mixture cut and fold the whites of eggs beaten until stiff. Pour into a buttered baking dish and cook thirty minutes in a moderate oven. Serve at once.

[1] In severe conditions and when eggs are forbidden this cannot be used.

"The food value of this dish, made with the above quantities, is almost exactly the same as that of a pound of beef of average composition and a pound of potatoes combined. It contains about 80 grams of proteids and has a fuel value of about 1300 calories. Estimated cost, 18 cents, calculated as explained.

"*Corn and Cheese Souffle*[1]

1 tablespoonful of butter.
1 tablespoonful of chopped green pepper.
¼ cupful of flour.
2 cupfuls of milk.
1 cupful of chopped corn.
1 cupful of grated cheese.
3 eggs.
½ teaspoonful of salt.

"Melt the butter and cook the pepper thoroughly in it. Make a sauce out of the flour, milk and cheese; add the corn, cheese, yolks and seasoning; cut and fold in the whites beaten stiffly; turn into a buttered baking dish and bake in a moderate oven 30 minutes.

"Made with skimmed milk and without butter, this dish has a food value slightly in excess of a pound of beef and a pound of potatoes. Calculated cost about 20 cents.

"*Welsh Rabbit*

1 tablespoonful of butter.
1 teaspoonful of cornstarch.
½ cupful of milk.
½ pound of cheese, cut into small pieces.
¼ teaspoonful each of salt and mustard.
A speck of cayenne pepper.

"Cook the cornstarch in the butter, then add the milk gradually and cook two minutes; add the cheese and stir until it is melted. Season and serve on crackers or bread toasted on one side, the rabbit being poured over the untoasted side. Food value is that of about three-fourths of a pound of beef. Calculated cost 13 cents.

"*Macaroni and Cheese No.* 1

1 cupful of macaroni, broken into small pieces.
2 quarts of boiling salted water.
1 cupful of milk.
2 tablespoonfuls of flour.
¼ to ½ pound of cheese.
½ teaspoonful of salt.
Speck of cayenne pepper.

[1] In severe conditions and when eggs are forbidden this cannot be used.

"Cook the macaroni in the boiling salted water, drain in a strainer, and pour cold water over it to prevent the pieces from adhering to each other. Make a sauce out of the flour, milk and cheese. Put the sauce and macaroni in alternate layers in a buttered baking dish. Cover with buttered crumbs and heat in oven until crumbs are brown.

"*Macaroni and Cheese No.* 2

"A good way to prepare macaroni and cheese is to make a rich cheese sauce and heat the macaroni in it. The mixture is usually covered with buttered crumbs and browned in the oven. The advantage of this way of preparing the dish, however, is that it is unnecessary to have a hot oven, as the sauce and macaroni may be reheated on the top of the stove.

"*Macaroni with Cheese and Tomato Sauce*

"Boiled macaroni may be heated in tomato sauce and sprinkled with grated cheese just before serving.

"*Italian Macaroni and Cheese*

1 cupful of macaroni broken into small pieces.
2 quarts of boiling salted water.
½ onion.
2 cloves.
1½ cupfuls of tomato sauce.
½ cupful or more of grated cheese.

"Cook the macaroni in the boiling salted water with the onion and cloves. Drain, remove the onion and cloves, reheat in tomato sauce and serve with grated cheese.

"*Baked Rice and Cheese No.* 1

1 cupful of uncooked rice and
4 cupfuls of milk;
or,
3 cupfuls of cooked rice and
1 cupful of milk.
2 tablespoonfuls of flour.
½ pound of cheese.
½ teaspoonful of salt.

"If uncooked rice is used it should be cooked in three cupfuls of milk. Make a sauce with one cupful of milk, add the flour, cheese and salt. Into a buttered baking dish put alternate layers of the cooked rice and the sauce. Cover with

buttered crumbs and bake until the crumbs are brown. The proteids in this dish, made with rice cooked in milk, are equal to those of nearly $1\frac{3}{4}$ pounds of average beef. If skimmed milk is used, the fuel value is equal to nearly $3\frac{1}{2}$ pounds of beef. Whole milk raises the fuel value still higher. Estimated cost, 28 cents.

"Baked Rice and Cheese No. 2

½ pound of cheese grated or cut into small pieces.	1 cupful of rice. Milk as needed.

"Cook the rice; put into a buttered baking dish alternate layers of rice and cheese; pour over them enough milk to come half-way to the top of the rice; cover with buttered crumbs and brown.

"If the rice is cooked in milk, either whole or skimmed, and one cup of milk is used to pour over it, this dish has as much protein as $1\frac{1}{4}$ pounds of beef of average composition, and a much higher fuel value.

"Baked Crackers and Cheese

9 or 10 butter crackers or Boston crackers. ¼ pound of cheese or 1 cupful of grated cheese.	1½ cupfuls of milk. ½ teaspoonful of salt. Flour.

"Split the crackers, if the thick sort are selected, or with a sharp knife cut them into pieces of uniform size. Pour the milk over them and drain it off at once. With the milk, flour, cheese and salt make a sauce. Into a buttered baking dish put alternate layers of the soaked crackers and sauce. Cover with bread crumbs and brown in the oven, or simply reheat without covering with crumbs.

"The above is a very satisfactory substitute for macaroni and cheese, and can be prepared in less time.

"Cheese Rolls

"A large variety of rolls may be made by combining legumes, either beans of various kinds, cowpeas, lentils, or

peas, with cheese of various kinds, and adding bread crumbs to make the mixture thick enough to form into a roll. Beans are usually mashed, but peas or small Lima beans may be combined whole with bread crumbs and grated cheese, and enough of the liquor in which the vegetables have been cooked may be added to get the right consistency. Or, instead of beans or peas, chopped spinach, beet tops, or head lettuce may be used. Home-made cottage cheese, and the soft cream cheese of commerce, standard cheese, or English dairy may be used.

"*Boston Roast*

1 pound can of kidney beans, or equivalent quantity of cooked beans.	Bread crumbs.
½ pound of grated cheese.	Salt.

"Mash the beans or put them through a meat grinder. Add the cheese and sufficient bread crumbs to make the mixture stiff enough to be formed into a roll. Bake in a moderate oven, basting occasionally with butter and water. Serve with tomato sauce. This dish may be flavoured with onions, chopped and cooked in butter and water.

"*Pimento and Cheese Roast*

2 cupfuls of cooked Lima beans.	3 canned pimentos chopped.
½ pound of cream cheese, commercial or home made.	Bread crumbs.

"Put the first three ingredients through a meat chopper. Mix thoroughly and add bread crumbs until it is stiff enough to form into a roll. Brown in the oven, basting occasionally with butter and water.

"*Nut and Cheese Roast*

1 cupful of grated cheese.	1 tablespoonful of butter.
1 cupful of chopped English walnuts.	Juice of half a lemon.
1 cupful of bread crumbs.	Salt and pepper.
2 tablespoonfuls of chopped onion.	

"Cook the onion in the butter and a little water until it is tender. Mix the other ingredients and moisten with water,

using the water in which the onion has been cooked. Pour into a shallow baking dish and brown in the oven.

"*Cheese and Spinach Roll*

2 quarts of spinach.
1 cupful of grated cheese.
1 tablespoonful of butter.
Salt.
Bread crumbs.

"Cook the spinach in water for ten minutes. Drain off the water, add the butter, cook until tender, and chop. Add the grated cheese, and then bread crumbs enough to make a mixture sufficiently stiff to form into a roll, or leave more moist and cook in a baking dish.

"*Breakfast Cereals with Cheese*

"That cheese combined with cereal foods makes a rational dish as regards the proportion of nutrients it supplies has been pointed out. Cheese and some of the crisp 'ready-to-serve' cereal breakfast foods is a combination which is common, the cheese being melted with the cereal food, or simply served with it.

"There are many who relish a piece of cheese with the cooked cereal so commonly eaten for breakfast and find such a combination satisfying to appetite and taste. Oatmeal or some other home-cooked breakfast cereal prepared with cheese is palatable, and such dishes have an advantage in that they may be served without cream and sugar. Since such a dish contains considerably more protein than the breakfast cereals as ordinarily served, it has a further advantage in that it may well serve as the principal item of a breakfast menu, instead of a preliminary to other courses. Such a combination as cereals cooked with cheese, toast, fruit, and tea, coffee, or chocolate, makes a palatable as well as nutritious breakfast, and one which does not require much work to prepare and to clear away. A recipe for preparing oatmeal with cheese follows. Wheat breakfast foods, either parched or unparched, corn meal and hominy, may be prepared in the same way.

"*Oatmeal with Cheese*

2 cupfuls of oatmeal.	1 tablespoonful of butter.
1 cupful of grated cheese.	1 level teaspoonful of salt.

"Cook the oatmeal as usual. Shortly before serving, stir in the butter and add the cheese, and stir until the cheese is melted and thoroughly blended with the cereal.

"The cheese should be mild in flavour and soft in texture. The proportion of cheese used may be increased if a more pronounced cheese flavour is desired.

"*Cheese with Mush*

"Cheese may be added to corn-meal mush or to mush made from any of the corn or wheat preparations now on the market. The addition of cheese to corn-meal mush is particularly desirable when the mush is to be fried.

"*Fried Bread with Cheese*

6 slices of bread.	½ teaspoonful of salt.
1 cupful of milk.	½ teaspoonful of potassium bicarbonate.
2 ounces of cheese, or ½ cupful of grated cheese.	Butter or other fat for frying.

"Scald the milk with the potassium bicarbonate; add the grated cheese, and stir until it dissolves. Dip the bread in this mixture and fry it in the butter. The potassium bicarbonate helps to keep the cheese in solution. It is desirable, however, to keep the milk hot while the bread is being dipped.

"CHEESE SOUPS AND VEGETABLES COOKED WITH CHEESE

"In these dishes the cheese is used not only to add nutritive value, but also to give its characteristic flavour either to materials otherwise rather mild in taste (as in potatoes with cheese), or to combine its flavour with that of some more highly flavoured vegetables (as in cheese and vegetable soup). The ingenious housekeeper whose family is fond of cheese can doubtless think of many desirable ways

of making such combinations besides those given in the following recipes:—

"*Milk and Cheese Soup*

3 cupfuls of milk, or part milk and part stock.
1½ tablespoonfuls of flour.
1 cupful of grated cheese.
Salt and paprika.

"Thicken the milk with the flour, cooking thoroughly. This is best done in a double boiler, with frequent stirrings. When ready to serve, add the cheese and the seasoning.

"The proteids in this soup are equal in amount to those in five-sixths of a pound of beef of average composition; its fuel value is higher than that of a pound of beef.

"*Cheese and Vegetable Soup*

2 cupfuls of stock.
2 tablespoonfuls of finely chopped carrots.
1 tablespoonful of chopped onion.
A very little mace.
2 tablespoonfuls of butter.
2 tablespoonfuls of flour.
1½ teaspoonfuls of salt.
1 cupful of scalded milk.
¼ cupful of grated cheese.

"Cook the vegetables a short time in one-half of the butter, add the stock and the mace, boiling fifteen or twenty minutes. Strain and add the milk. Thicken with flour cooked in the remaining butter. Just before serving, stir in the cheese and cook until it is melted.

"*Potatoes with Cheese Sauce*

"Cut boiled potatoes into cubes and serve with cheese sauce No. 1. This is one of the cheese and vegetable dishes most frequently found on restaurant menus.

"Cheese Salads, Sandwiches, and Similar Cheese Dishes

"Cheese of one sort or another is a very common accompaniment of salads, and the combination is rational as well as palatable, for the constituents of the succulent foods —chiefly water and cellulose, supplement the protein and fat of the cheese. Cheese is often used also as a part of the salad.

"A number of recipes are given below for cheese salads and other cheese dishes which may be served with dinner or other regular meals, or served as part of a special lunch or special supper. Many of the cheese dishes discussed in other sections are also commonly used for such occasions when something savoury is desired which can be easily and quickly prepared.

"*Cheese with Salads*

"Cheese or cheese dishes are an acceptable addition to salads. Neufchâtel or other cream cheese, either plain or mixed with pimentos and olives, may be passed with lettuce, or may be cut into slices and served on lettuce.

"Cheese balls are often served with salad. They are made of some soft cream cheese, and are frequently combined with chopped chives, olives, sweet peppers, chopped nuts, etc., for the sake of adding flavour. Cooked egg yolk, spinach extract, etc., are sometimes mixed in for the sake of colour. If the balls are rolled in chopped chives or parsley, both flavour and colour are supplied.

"*Plain Cheese Salad*

"Cut Edam or ordinary American cheese into thin pieces, scatter them over lettuce leaves, and serve with French dressing.

"*Olive and Pimento Sandwich or Salad Cheese*

"Mash any of the soft cream cheeses and add chopped olives and pimentos in equal parts. This mixture requires much salt to make it palatable to most palates, the amount depending chiefly on the quantity of pimento used. The mixture may be spread between thin slices of bread or it may be made into a roll or moulded, cut into slices, and served on lettuce leaves with French dressing.

"*Cheese and Tomato Salad*

"Stuff cold tomatoes with cream cheese and serve on lettuce leaves with French dressing.

"*Cheese and Pimento Salad*

"Stuff canned pimentos with cream cheese, cut into slices, and serve one or two slices to each person on lettuce leaves with French dressing.

"*Cheese Jelly Salad*

½ cupful of grated cheese.	1 cupful of whipped cream.
1 tablespoonful of gelatin.	Salt and pepper to taste.

"Mix the cheese with the whipped cream, season to taste with salt and pepper, and add to the gelatin dissolved in a scant cupful of water. This may be moulded in a large mould or in small moulds.

"When the jelly begins to harden, cover with grated cheese. The jelly should be served on a lettuce leaf, preferably with a cream dressing or a French dressing to which a little grated cheese has been added.

"*Cheese Salad and Preserves*

"Epicures have devised a dish which consists of lettuce with French dressing served with cream cheese and thick preparations of currants or other fruits preserved in honey or sugar, which, owing to the fact that the seeds have been extracted by a laborious process, are fairly expensive. The soft cheese often found in market is also relatively expensive. There is a suggestion in this dish, however, for others which are much less costly. Buttermilk cream or ordinary cottage cheese served with lettuce or other green salad and a small amount of rich home-made preserves is a combination with much the same character, and also very appetizing.

"*Cheese and Celery*

"Cut stalks of celery having deep grooves in them into pieces about two inches long. Fill the grooves with cream cheese salted or flavoured with chopped pimentos, and serve with bread and butter as a salad course or serve as a relish at the beginning of a meal.

"Although not cheese dishes, strictly speaking, the

following salad dressings made with buttermilk cream may be included in this section.

"*Buttermilk Cream Salad Dressing*

½ cupful of buttermilk cream.
1 tablespoonful of vinegar.
¼ teaspoonful of salt.
Cayenne pepper.

"This dressing is particularly suitable for serving with cucumbers.

"*Buttermilk Cream Horseradish Salad Dressing*

"To buttermilk cream add a little grated horseradish and vinegar and salt. Serve on whole or sliced tomatoes.

"*Cheese Sandwiches*

"Mash or grate American cheese, add salt, a few drops of vinegar and paprika, and a speck of mustard. Mix thoroughly and spread between thin slices of bread.

"*Cheese and Anchovy Sandwiches*

"To the mixture mentioned in the preceding recipe add a little anchovy essence. Sardines mashed or rubbed into a paste or any other fish paste may be used in a similar way.

"*Pimento, Olive and Cheese Sandwiches*

"These sandwiches are referred to previously.

"*Cuban Sandwiches*

"This sandwich may be described as a kind of club sandwich with cheese. It is usually made large, so that it is necessary to eat it with a knife and fork. It may be made in such proportions as to supply a large amount of nourishment.

"Cut the crusts from slices of bread. Between two slices lay first lettuce with a little salad dressing or salt on it, then a slice of soft mild cheese, and finally thin slices of dill pickles or a little chopped pickle.

"*Toasted Cheese Sandwiches*

"Plain bread and butter sandwiches with fairly thick slices of cheese put between; the slices are frequently toasted, and on picnics, or at chafing-dish suppers, are often browned in a pan in which bacon has just been fried.

"Cheese Pastry, Cheese Sweets and Similar Dishes

In the foregoing pages a large number of recipes have been included in which cheese is combined with materials without cooking, as in salads, or used in cooked dishes of creamy or custard-like consistency, as in souffles and Welsh rabbit, or in combination with vegetables or cereals, such as rice.

"There are a number of cheese dishes of quite different character in which the cheese is combined with dough, batter, or pastry in various ways, and a number of dishes in which cheese or cheese curd is used in combinations suitable for dessert. Such sweet dishes were once much more common than they are to-day, as reference to old cookery books will show, but some of them are well worth retaining.

"In cheese sweets, flavour and richness are both contributed by the cheese.

"When cheese is used in pastry or dough it may serve simply as a flavour, as in cheese sticks or cheese straws, or it may wholly or in part replace with its fat the usual shortening, as butter or other fat, and with its protein (casein) the protein (albumin) of eggs. As an illustration of such a use of cheese, gingerbread may be cited.

"Using cheese in this way is often an economy when eggs are scarce. Better results will be obtained if soft cheese is used, which can be worked into the dough in much the same way as butter or other shortening. To those who like cheese, the flavour which it imparts would be an advantage. However, if a very mild cheese is used in combination with molasses or spice, the dish differs a little in flavour from one prepared in the usual way.

"CHEESE PASTRIES AND SIMILAR DISHES

"*Cheese Biscuit No.* 1

2 cupfuls of flour.
4 teaspoonfuls of baking powder.
2 tablespoonfuls of lard or butter.
⅔ of a cup of milk.
½ teaspoonful of salt.
Grated cheese sufficient to give desired flavour.

"Mix all the ingredients excepting the cheese as for baking-powder biscuits. Roll thin, divide into two parts, sprinkle one half with grated cheese, lay the other half of the dough over the cheese, cut out with a small cutter, and bake.

"*Cheese Biscuit No.* 2

½ pound of soft cheese.
2 cupfuls of flour.
1 cupful of water.
4 teaspoonfuls of baking powder.
1½ teaspoonfuls of salt.

"Mix and sift the dry ingredients, then work in the cheese with a fork or with the fingers, and add the water gradually. The approximate amount of water has been given; it is impossible to give the exact amount, as flour differs in its capacity for taking up moisture. Toss the dough on a floured board and roll out and cut with a biscuit cutter. Place in a buttered pan and bake in a quick oven from twelve to fifteen minutes. The biscuit may be sprinkled with cheese before being put into the oven.

"If the cheese is sufficiently soft it can be measured, just as butter is. This recipe then would call for a half cupful.

"*Cheese Wafers*

"Spread grated cheese on thin crackers, heat in the oven until the cheese is melted. Serve with soup or salad.

"*Cheese Relish*

"Spread bread which has been toasted or fried in deep fat with grated cheese, or with grated cheese mixed with a little mustard, then heat in the oven until the cheese is melted. This may be served with salad, or as a relish to give flavour to some dish, such as boiled rice or hominy, which has no very marked flavour.

"Cheese Straws

"Roll out plain or puff paste until one-fourth of an inch thick. Spread one-half of it with grated cheese. Fold over the other half and roll out again. Repeat the process three or four times. Cut into strips and bake. Serve with soup or salad.

"Cheese Gingerbread No. 1

1 cupful of molasses.
4 ounces of cheese.
1 teaspoonful of soda.
½ cupful of water.
2 cupfuls of flour.
2 teaspoonfuls of ginger.
½ teaspoonful of salt.

"Heat the molasses and the cheese in a double boiler until the cheese is melted. Add the soda and stir vigorously. Mix and sift dry ingredients, and add them to the molasses and cheese alternately with the water. Bake fifteen minutes in small buttered tins.

"Cheese Gingerbread No. 2

½ cupful of molasses.
½ cupful of sugar.
4 ounces of cheese.
2 cupfuls of flour.
1 teaspoonful of soda.
2 teaspoonfuls of ginger.
½ teaspoonful of salt.
¾ cupful of water.

"Rub the cheese and the sugar together. Add the molasses. Mix and sift the dry ingredients and add them to the cheese mixture alternately with the water.

"Cheese Cakes.

1 quart of milk.
Rennet.
1 oz. of sugar.
Yolks of 2 eggs.
A speck of nutmeg.
1½ z. of butter.
1 oz. of dried currants or small raisins.

"Warm the milk and add the rennet, using the amount prescribed on the package. Let the milk stand until the curd forms, then break up the curd and strain off the whey. Add the other ingredients to the curd; line patty tins with pastry, fill them with the mixture and bake.

"Brown Betty with Cheese

"Arrange in a deep earthenware baking dish alternate layers of bread crumbs and thinly sliced apples. Season with

cinnamon, also a little clove if desired and brown sugar. Scatter some finely shaved mild full-cream cheese over each layer of apple. When the dish is full, scatter bread crumbs over the top and bake thirty to forty-five minutes, placing the dish in a pan of water so that the pudding will not burn.

"If preferred, this may be sweetened with molasses mixed with an equal amount of hot water and poured over the top, a half cupful of molasses being sufficient for a quart pudding dish full.

"Cheese may be used in place of butter in a similar way in other apple puddings. Apple pie made with a layer of finely shaved cheese over the seasoned apple and baked in the usual way is liked by many who are fond of cheese served with apple pie.

"CONCLUSION.—In the foregoing pages information has been summarized regarding the food value of cheese, and ways of preparing it for the table. It has been pointed out that, judged by the kind of nutrients it supplies—chiefly nitrogenous material and fat—and the proportion in which they are present, it resembles such food-stuffs as meat, fish, and eggs, which means that, like them, its rational use in the diet is in combination with other staple foods to form well-balanced meals.

"Experiments have shown that when eaten either raw or carefully cooked, cheese is as thoroughly digested as other staple foods, and is not likely to produce physiological disturbance.

"An ounce of cheese roughly is equivalent to 1 egg, to a glass of milk, or to 2 ounces of meat.

"Although uncooked cheese resembles meat in composition, cheese dishes prepared after ordinary recipes, with milk and shortening, are likely to contain more fat than meat dishes prepared in the usual ways. When, therefore, such cheese dishes are served with other staple foods the combination is likely to contain more fat than the usual meal. If little fat is ordinarily used this may be an advantage. If a great deal of fat is ordinarily used it may be desirable to lessen the amount in the cheese dishes. This can readily be

done by omitting the shortening and using skim milk or water in the preparation of such dishes, a change which also lessens their cost.

"The fact that cheese, like meat, contains neither starch nor cellulose suggests that, like meat, it should be combined with bread, potatoes, and other starchy foods, with vegetables and with sweets. The concentrated character of cheese and many cheese dishes suggests the use of succulent fruits and vegetables with them. The high percentage of fat in cheese suggests the use of correspondingly small amounts of fat in the accompanying dishes, while the soft texture of cheese dishes as compared with meat makes it reasonable to serve the harder and crustier breads with them.

"Though cheese is so generally used in some way in most families, yet the making of menus with cheese as a central dish is less well understood than more usual food combinations, since there is less experience to serve as a guide. More thought is therefore usually required to arrange such cheese meals in order that they may be palatable and at the same time reasonable in nutritive value.

"In order that the diet may remain well balanced, cheese, if used in quantity, should replace foods of similar composition rather than supplement them. The builder who has a choice of materials must have a knowledge of their relative properties if he wishes to use stone instead of brick, or wood in place of iron. It is the same with the housekeeper who wishes to use her available food supply intelligently, and whose choice of foods is influenced by their relative cost at a given time or season. The woman who has a knowledge of the relative food value of different articles of diet, and their real food qualities as distinguished from their market value, who understands good methods of cooking and serving foods, and who plans her meals and other housework so that unnecessary labour and expense may be avoided, is taking account of the things which make for economical living as well as for good living.

"Some persons seem to believe that cheese or fish or other food is the ideal food for some particular circumstance,

and that there is a special food or diet suited to each kind of work and to every circumstance of our daily life, and that it would be a great advantage if we could regulate our daily fare with the accuracy a chemist uses in making an experiment. Work, recreation, the amount of clothing we wear, and other details of our daily life are not so regulated, and it is the belief of those who have studied the subject that the best interests of persons living under normal conditions are served if the ideal be rather the regulation of the diet along general lines in accordance with good sense, the teachings of experience, economy and the available knowledge gained from a scientific study of the subject, due care being taken that the different staple food-stuffs are so combined that all the needs of the body are provided, excessive waste is prevented, and that both undernourishment and excess or overeating are avoided.

"Dishes which are liked, and the methods followed in preparing them, will vary in different countries and at different times, yet this does not of necessity mean that the nutritive value of the diet varies correspondingly. In the same way, it is possible for us to vary the selection of our foods and the character of our diet at will, according to the demands of our taste and our purse, without correspondingly changing its value for supplying the needs of the body. This means that the housekeeper, in suitable ways, can use cheese, meat, fish, eggs, and other foods of similar composition as substitutes for one another, being governed by their relative market value at different times and seasons, by the tastes of her family, and similar considerations. If she uses the different food-stuffs with reference to their nutritive value and is skilful in preparing foods in appetizing ways and in serving them in attractive combinations, the daily fare may be both adequate and pleasing, whether she selects cheese or meat or fish or eggs or other foods to supply nitrogenous material and fat. Here, as in all that pertains to housekeeping, true economy is dependent upon a knowledge of materials and skill in using them."

The quantitative regulation of diet has always been a

matter of great difficulty, and usually impossible of attainment under the usual conditions of medical practice.

In the first place, most people have no actual knowledge of weights and measures, not to mention the metric system, which is usually employed in measuring food in ordering diet. Then the gentleman who is on a diet usually objects to limiting his food before his appetite is satisfied, and few physicians wish to exercise the fortitude required to compel anyone to go hungry.

After a faithful attempt to carry out the low-protein and caloric diet, the author is happy, indeed, to have discovered an easier and, at the same time, a more effective plan. The quantitative diet usually aimed at is the *low-protein diet*, and is founded on the belief that the kidneys must be spared by limiting the nitrogen intake. The *few-protein diet* is founded on the belief that the necessity for a diet depends upon sensitiveness to particular proteins more than upon a general intolerance for protein food; the number (not quantity) of proteins is reduced to a minimum.

This is accomplished in a simple way. We can usually disregard the vegetable proteins, and, by removing from the dietary meat, fowl, eggs, fish and stock soups, obtain a diet without *positive* objection. Then to remove the *negative* objection of an insufficiency of protein, we put back into the dietary one protein which has, in general, or in the particular person, proved to be safe.

In severe conditions, where there is pain in the region of the heart, cheese is the one usually chosen. So the man is told to eat as freely as he wishes of bread and butter, vegetables, fruit and nuts, with cheese. Milk is allowed, but not insisted on in large quantities, as the albumins of milk seem to disagree in some instances of kidney disease, while cheese is uniformly well borne. At the same time, an out-of-door life is advised, and at intervals of a week the weight is taken and the hæmoglobin of the blood tested. The weight does not usually vary more than a few pounds on this diet, the quality of the blood approaches normal, and the general physical strength is maintained.

Nearly all irregularities of the bowels and stomach are best corrected by castor oil. In severe arteriosclerosis which has been previously neglected or wrongly treated it is well to commence by giving an ounce of castor oil every second day for three doses, then once a week for a while, then once in two weeks, and later once a month. The diet ordinarily renders the bowels regular, instruction being given to disregard the lack of a movement on the day following the oil, as the thoroughness of the previous action makes this permissible.

Contrary to the expectation of the old dyspeptic, this diet is not followed by "wind on the stomach," but, on the contrary, when the liver is relieved of the offending amino acids and room is made for the use of carbohydrates by the diminution of proteins, the former are well borne.

It is needless to remind the reader that the questions of acidosis and diabetes require consideration that is out of place when advising as to the care of the arteriosclerotic without these complications.

On practical grounds, the few-protein diet is to be recommended because it is successful. The reason for this must be sought in a different theory of arteriosclerosis from those usually given. Let us for a few moments discuss what might be called continuous subsymptomal anaphylaxis and the possibility that this is what is corrected by the few-protein diet.

It has long since become apparent that there is a real difficulty in the problem of arteriosclerosis, because hardly two observers have so far agreed upon its nature and the philosophy of its treatment. The reason for this is that its moving pathology and its pathologic anatomy bear so little relation to each other. Whatever other elements may be mentioned as a cause, the one that is never omitted is auto-intoxication. Sometimes this word is used, and others speak of it more indefinitely as errors of diet, and so on. Taking the consensus of opinion of all writers, we find that a poisoning of the system and its effect upon the circulation is unanimously selected as a cause of arteriosclerosis.

The next number of votes is cast for the infectious diseases. Hard work and worry have a minority of supporters.

When things go wrong in the political world, and there are too many candidates in the field, an alliance is usual. On what common ground can we unite all the carefully formed opinions of competent observers?

It seems to me it is possible to find a solution in the light of our recently acquired knowledge of the reactions of animal proteins and their relations to the cells of the body.

The astonishing work of Dr. Carrell, who has prolonged the life of tissues outside of the body, emphasizes the fact that life is in the cell, and not in the working combinations of the organs that constitute the living human body.

In the author's opinion, arteriosclerosis is a disease of the cells and not primarily a disease of the organs, and it is only as we constantly bear this in mind that the nature of the disease becomes clear and a cure seems possible.

Thus far our argument includes the acceptance of a toxic cause for arteriosclerosis, and the fact that life resides in the cell and not in the body as a whole.

The next point of observation is the vast number of people who have evident food idiosyncrasies; or, in the modern nomenclature, the frequent occurrence of sensitiveness to particular foods; or, to be more precise, sensitiveness to particular proteins.

Remembering these three points, the toxic cause of arteriosclerosis, the residence of life in the cell, and the possibility of these cells being sensitive to particular proteins, we must go on to another fact, and that is, that many diseases are subsymptomal or without symptoms, until they reach a certain degree of development. In this condition diseases are hard to recognize, so we have to study them in their fully developed state. Protein sensitiveness in its most fully developed state is represented by the phenomenon of anaphylactic shock. If an animal be injected with egg albumin it is sensitized to this substance; if, later, more egg albumin is

injected, the animal becomes strikingly ill, and perhaps dies.

A physician told me the other day that his child was so sensitive to fish that when it was tested by concealing a few fragments of codfish in a large potato ball, the child broke out in eruption before it had time to leave the table.

A study of the food reactions of the community would show all degrees of sensitiveness to food,—from those with severe symptoms in gradually diminished scale, to those with symptoms barely noticed and probably uninterpreted, and finally not noticed at all (subsymptomal).

The person who is highly sensitive to food is safe from that particular food, as it carries its own penalty with it. A person who is sensitive to food and is not consciously disordered by it can go on for years taking that food into his system until the cells are finally damaged by the constantly repeated, or continuous, irritation.

So we now have four points: the toxic nature of arteriosclerosis; the residence of life in the cells; the sensitiveness to particular proteins, and the probability of the existence of an unrecognized sensitiveness that does not lead to conscious symptoms from particular proteins found in ordinary articles of food.

From these considerations we are ready to proceed to a logical management of this most fatal of diseases. Here again, the universal opinion and experience of mankind coincide with our conclusion. The prejudice against animal food in arteriosclerosis is universal, and it is easy to conclude that, while the vegetable proteins are capable of producing symptoms, they seldom do damage.

The only novel idea that needs to be added is that the damage does not come from animal protein as such, but from particular animal protein to which the person in question is sensitive.

For some reason red meats are under greatest suspicion throughout the world for chronic food poisoning, while fish is accused of acute food poisoning. Other things, in some way, have escaped much criticism, though examples of egg

sensitiveness can be picked up anywhere by a little conversation with people as to whether they eat eggs or not.

Government investigations and clinical experience prove that the prejudice against cheese rests mainly in the Welsh rabbit eaten late at night under unhygienic conditions.

In order to avoid subsymptomal anaphylaxis, it is very often only necessary to exclude animal proteins from the dietary completely, and then put back in the dietary one, such as cheese, to provide the necessary nourishment to the body. This constitutes a few-protein diet. In others, chicken is given; and in some, eggs.

The distinction between the low-protein and the few-protein diet needs to be appreciated. The few-protein diet is founded upon the *qualitative* idea that particular articles of food become harmful to certain individuals; and also, that the amount of damage is not in proportion to the amount of such harmful food.

The low-protein diet is founded upon the idea that the important lesion in cardiovascular disease is found in the kidneys, and that since the chief function of the kidneys is to excrete nitrogen, by this diet the kidneys are spared, with a consequent improvement in the whole situation.

As a clinical fact founded upon experience, the low-protein diet has shown benefit, but in my own practice it has not shown anything like the brilliant results of the few-protein diet, even when the quantity of nitrogen was the same.

There are many ideas current that bear in favour of the few-protein diet. Perhaps the most striking of these is this prejudice of most physicians against red meat. From some points of view, to distinguish between red meats and meats of other colours seems to be an absurdity; but when we appreciate the delicacy of this matter of sensitiveness to proteins, in that an individual is benefited by one protein and injured by another that is almost identical, we cannot but allow the possibility that this old distinction may be founded upon a sounder basis than can be explained on usual grounds.

An hour or so before writing this I was talking to a gentleman in my consulting-room who had, mysteriously to him, developed cardiovascular disease involving cardiac hypertrophy, an habitual blood pressure of 170 mm. Hg, and a few casts in the urine, but without special conscious symptoms. This gentleman told me that he could always produce a headache by indulging freely in red meat, and that he had tested the matter so often that there was no doubt as to the relationship. In searching for something in his history to account for his acquired sensitiveness to meat, I found that early in life he had had a very severe

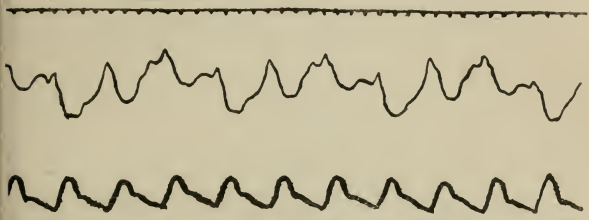

FIG. 14.—Polygraph tracing from Mr. C., after recovery of compensation.

attack of dysentery, and this was the only illness he had had that he could remember.

Within a short time I also saw an officer in the United States Army Medical Services who presented similar symptoms in a very advanced stage, whose sensitiveness seemed to have its origin in a very severe attack of amœbic dysentery in the Philippine Islands a few years before. (Fig. 14 shows an increased A–C interval.)

Another gentleman, now under observation, seems to date his sensitiveness to particular protein from an attack of gall-stones involving a prolonged illness with great emaciation and other concomitant symptoms that were relieved by an operation.

A knowledge of the distinction between a low-protein diet and a few-protein diet is of supreme importance in the management of persons during the convalescent period

of diseases which are known to lead to arteriosclerosis. One of these is typhoid fever. A large nitrogen food content seems to be desirable during the convalescent period of such a severe disease, but with the knowledge that nearly all typhoid sufferers after a while show latent arteriosclerosis, we should hesitate to order large quantities of protein food, for the fear that cardiovascular disease may be hastened or increased. If we believe that the arteriosclerosis is not so much the direct result of the disease as a sequence of acquired sensitiveness to particular proteins, then, selecting safe proteins, there need be no particular limit as to quantity.

The instances of acquired sensitiveness following illness are not at all uncommon in popular experience. We often hear it said of a person, that formerly he was fond of a certain kind of food, but since some particular illness he had never been able to take it.

The method of deciding whether a person is sensitive to particular proteins or not will be discussed elsewhere. We are now discussing the distinction between the *low*-protein diet and the *few*-protein diet.

Mr. D. illustrated in his history the most straightforward example of sensitiveness to particular protein food, with unexpectedly good results from a strict regimen, that has yet come to my notice.

Mr. D.'s father lived to the age of sixty-three; his mother was fifty-six when she died. His wife was living and well, and he had no children.

He was a very stout, blonde gentleman, fifty-six years of age. He said he had not been feeling up to his general condition for about a year, but he had no particular complaint. He went south for a vacation, and when in Miami he had an attack easily recognized from his description as acute suffocative œdema, and was attended by Dr. Peter T. Skaggs, of Miami, Florida. Then Mr. D. decided to come home, and on the way home he had another attack at Rockledge.

Soon after his return he came under my care. At this

time he was in a truly pitiable condition, with shortness of breath, swelling of the legs, very high blood pressure—220 mm. Hg—considerable dilatation of the heart as shown by the gallop rhythm, loud systolic murmurs both at the base and apex, and an increased area of dulness.

On my advice he went into my sanatorium, and was under treatment for a number of weeks, which was required to restore his cardiac compensation. During this time he had several attacks of suffocative œdema, a troublesome cough, and a very persistent œdema of the lungs, as shown by moist râles.

The rest treatment alone was tried only because repeated experiment proved that he had an idiosyncrasy against digitalis and it was impossible to obtain the specific effect, so practically the restoration of the heart came about gradually without its use. The removal of the cause, by putting him on a few-protein diet, was the important element.

In a couple of months his blood pressure had fallen to 160 mm. Hg; he had good wind; his hæmoglobin was 85 per cent.; pulse rate, 88; and he was able to resume business.

After this he continued to improve, so that he was able to drive his own automobile and attend to his very exacting business as superintendent of a seaside resort.

An examination made for the purposes of this writing shows his condition as that described, with blood pressure of 160 mm. Hg; hæmoglobin, 90 per cent.; weight, 166 pounds; bowels, sleep and appetite satisfactory. He has not departed at all from his regimen, which consists of a few-protein diet, the nitrogenous food being supplied by cheese; a full dose of castor oil once a month, and out-of-door exercise.

An analysis of Mr. D.'s history shows that he was so situated as to be supplied with an abundance of fresh fish, of which he was inordinately fond, and for several years he had eaten it in large quantities. It is fair to draw the conclusion that, in the absence of any other cause, the

protein to which he was sensitive was derived from this source.

At any rate, a complete arrest of the serious damage and a restoration of health followed the elimination of this article of food, though it has not been wise as yet to risk eggs or meat.

The reader is warned that in this book we are studying the *disease*, and not merely lesions of arteries. Anyone who still has the conception of arteriosclerosis as merely a disease of the arteries has not accepted the conclusions of practically all authorities who have observed extensively.

The disorder to which this non-descriptive name has been attached is one that involves, or at least endangers, every tissue in the body. The arteries, being generally distributed and suffering in two ways—by direct poisoning of the cells and by the strain of increased function—do indeed most early show signs, and at last suffer most; but coincident with this is likewise poison damage to the tissue of the heart, kidneys, liver, and, in lesser degree, other organs.

Chronic intoxication would be a better name, or chronic malnutrition of the arterial type. It is too soon to change the name, but some day this will come to pass.

X

ANGINA PECTORIS

The following histories illustrate one of the most important topics in the study of arteriosclerosis, namely, the question of cardiac pain.

One of the men I have known for a long time; in fact, his family were among the first I had when I began practice. The other I have known only a short time. He was sent to me from the coal regions of Pennsylvania.

The first came to me in 1908, complaining that whenever he started to walk he was seized with a pain which he described as gripping him at the throat and spreading down his left arm to his fingers,—a pain which, at times, was excruciating.

I think the second man's description of the pain of angina pectoris was unique. He said that when a boy he once had a cold, with pain in his chest, and his mother put a plaster on his chest. He was a vigorous young fellow, and his chest was covered with hair. He got over his cold and wanted to go in swimming one day, and he thought his plaster constricted his chest, so he pulled it off. He said it hurt pretty badly—I won't use his exact words—and the pain he had when he pulled that plaster off, pulling the hair with it, was the same pain he suffered when he had these heart attacks. Curiously enough, when he told me about this, I called in the other gentleman who happened to be in the room, and the latter said he had the same pain, and thought it a very graphic description.

The man, who had been under observation for upwards of five years, when he began treatment was so badly

off that he could not walk a hundred yards without having constricting pain across his chest, bringing on one of his attacks. I am happy to say that at the present time he is almost free from discomfort, is carrying on the occupation of a clerk in a police court—I think the busiest court in New York—and he is able to do this work from nine in the morning till seven at night. He is also able to walk without discomfort. This is the result of very patient and prolonged treatment.

The man from Pennsylvania was a druggist. He was fifty-seven years of age, and he said that for four years he had suffered from pain in his chest. At first these attacks were infrequent, but as time went on he had eight or ten a day, characterized by intense agony. The attacks were so bad that, as he said, if he were standing on a railroad track and a train were coming toward him, he could not move to get out of the way. Otherwise the man was pretty healthy. His wind was not very good, his heart sounds were abnormal and his blood pressure was elevated to 150 mm. Hg, but on the whole the man presented the appearance of health. He had, of course, received a great deal of treatment, and, being a druggist and allied with the profession, he had received all the advice he could get in his own neighbourhood, but he obtained no relief. A peculiar phase of his disease was that the pain was all on the right side; he seldom had discomfort on the left. This location of pain is commoner than one would suppose.

There is sometimes doubt as to what these attacks shall be called (and this man placed great store on the name given to his disease). Whether we shall call it plain, ordinary angina pectoris, or whether we shall find examples of pseudo-angina pectoris; or again, whether we shall delude ourselves (as had some of the physicians this man had seen) and call it pain due to nerves, or to a collection of wind on the stomach or something else—whatever we do is a matter of personal judgment.

Personally, I have never, in recent years, made a diagnosis of pseudo-angina pectoris. I think this name is silly. If a

man has a severe cardiac pain, he has angina pectoris, because that is the only clinical name for the worst form of cardiac pain. The simplest kind of cardiac pain can develop into the most serious.

I believe that angina pectoris is invariably a cardiac pain, and originates in the heart muscle. The fact that these attacks are precipitated by the slightest exertion is fairly certain evidence that the origin is in the heart muscle. Upon the slightest exertion the blood pressure is immediately slightly raised, bringing a sudden temporary increase in the work of the heart, and in certain conditions of disease of the heart muscle precipitates an attack of pain. It is hard to escape the idea that there is a cramp in some of the fibres of the heart.

I was rash enough to promise this man from Pennsylvania that he could be relieved in a great measure from his attacks. It is not my belief that a case of four years' standing with attacks of pain eight or ten times a day can be completely cured, but I felt assured that this man could be cured so as to have only an occasional attack, and to him that meant a great deal.

How can we relieve angina pectoris?

We cannot relieve it by drugs to cover up the pain; that is simply begging the question. We have to do that very often, but never with the cure of disease in view. In order to cure the disease we must understand its nature, find out its cause, and attempt to remove that cause.

Angina pectoris, in my student days, and in a good many books at the present time, is counted as a sort of enigma; why people have attacks of cardiac pain, what is the cause and nature of them, is supposed to be a great mystery.

I may be wrong, but it seems clear to me, because I cannot see any fallacy in the train of argument that explains it. The fact that the first man described has been relieved of his attacks and is able to do his work is some proof.

I have at hand a book on arteriosclerosis, and (as a matter of interest) I looked up angina pectoris to see what the author said of its cause. He says:—

"Arteriosclerosis may be marked in some vessels and so slight in the peripheral vessels that it cannot with certainty be made out. But when the radials are sclerosed it is usually the case that similar changes exist in other parts. Then, too, there may be marked changes at the root of the aorta leading to sclerosis of the coronary vessels alone, and the first intimation that the patient or anyone else has that there is disease may be an attack of angina pectoris. Except for symptoms on the part of the heart, there is no way to make the diagnosis of sclerosis of the coronary arteries."

Thus, picking up a book at random, I found a man who believed angina pectoris to be due to disease of the coronary arteries. This is a fairly universal belief, and the conditions are such that sclerosis of the coronaries usually accompanies severe angina. It occurs in the same person. Muscular cramp is what causes pain. Everyone has had, some time or another, a pretty bad pain. They have had pain after having eaten something that ought not to be eaten, or a pain after taking a very strong laxative. This pain is due to muscular spasm of the unstriped fibres of the intestines. In other words, it is due to an extra strain on the involuntary muscle fibres because they are trying to do something that they are unable for the moment to accomplish. The stomach or intestines were trying to do something beyond their power; the result was spasm. If it was a green apple that was eaten, the intestine was trying to force it along the intestinal tube, and the minute it succeeded the pain was relieved.

I believe that the pain of angina pectoris is exactly analogous to the excruciating pain described above that has its origin in the intestines and is referred to the region of the intestines. The pain of angina pectoris is due to the fact that there is disease of the heart muscle, that certain of the fibres of the heart are debilitated and weak, and these fibres are not able to respond properly to some demand upon them; this is the cause of cardiac pain. It has its origin in the heart muscle, and is due to weakness of certain fibres of the heart. So when one of these men I have spoken of felt pain over his heart after extra work, it was because the heart tried

to respond and some of the fibres were unable to do so easily; this gave rise to a pain, and that pain was referred to the surface of the body.

This theory explains cardiac pain so simply and all the grades—from the slightest pain that a person has with a slight degree of dilatation to the most severe angina—that I see no reason to switch off and say that pain of this kind has its origin in the coronary arteries. I believe that all cardiac pain has its origin in the heart muscle. A blocked coronary, of course, causes a local disturbance of muscle function.

At this point it is well to recall something of the so-called reflex protective phenomena. It may be repeating something that everyone knows. Angina pectoris is only an example of a reflex protective phenomenon. When anything goes wrong, the nervous system responds. There are nerves that have nothing to do with motion, sensation and so on. Every organ is intimately connected with the central nervous system in various ways. Whenever anything goes wrong with one of the organs, the nerves transmit a certain influence to the spinal cord, and if the something wrong is serious and continuous, it creates a profound impression on the spinal cord, so that the reflexes are altered, abolished or increased, and spinal irritation is caused. Spinal cord irritation is a matter of a great deal of importance.

But to get to the point of specific instance. In the case of the weak heart muscle, we have a persistent irritation at that level of the spinal cord that corresponds to the heart, and this part undergoes certain functional, and perhaps structural, changes. Passing through the level of the spinal cord, from the brain to the surface of the body, are sensory nerves whose business it is to convey sensation and pain. These are the nerves of pain from the posterior spinal roots. Whenever one of the automatic organs, like the heart or intestines, is unable to do some task it should be able to do, this failure irritates the level of the spinal cord corresponding to it, and the sensory nerves passing through that level give rise to a sensation of pain; the pain, of course, is

appreciated by the brain, and the brain, having no way of knowing where the sensation comes from, refers it to the usual source of sensation of the nerves. It seems to come from the surface of the body, according to the distribution of the nerve. If I knock my ulnar nerve near the elbow I feel pain distributed to my fingers; that is the most familiar example of a nerve giving pain from irritation of the trunk referred to the periphery and appreciated by the brain.

The pain of angina pectoris is exactly the same in its philosophy as the pain you have in your hand when you hit your elbow. It is due to the irritation of a sensory nerve.

Dislocation of this pain is very interesting. You never get dislocation of pain in early heart disease. A person with dilatation of the heart or dilatation just begun will have tenderness over the apex or over the region of the heart, but when that pain has existed for years and years and recurred again and again, it is dislocated into almost every part of the body because the irritation of the spinal cord spreads up and down. The distance to which the irritation spreads in the spinal cord is small, but at the periphery the distance, for instance, from one arm to the other, seems very great.

The cause of disease of the heart muscle in these chronic conditions developing pain, I am firmly convinced, is, nine times out of ten, some form of toxæmia, and usually I believe it is some protein against which that person is defenceless. I know that this was so in the first man described—the man who was relieved after prolonged treatment. He had the most persistent indicanuria that I have ever followed.

The problem of treating angina pectoris is the problem of taking care of the heart muscle. In the first place, if we can prove an intestinal putrefaction we can continuously treat that with such different methods as suggest themselves. The few-protein diet, outdoor exercise, and the use of castor oil at regular repeated intervals are the most essential parts of the treatment. In addition, high rectal irrigations may be employed, and the lactic acid bacillus treatment according to the system of Metchnikoff. Some physicians have faith in antiseptics, but I find in talking to physicians—I mean real

physicians, those who have observed—that most have abandoned the idea of treating intestinal putrefaction by intestinal antiseptics. However, it is such an obvious idea, and seems so simple, that it will always be suggesting itself. The trouble is that antiseptics do not work, and may give a false sense of security.

In the average person the intestinal putrefaction, with perhaps an idiosyncrasy against certain proteins, continues for months and years without being recognized. The heart muscle is damaged, certain muscle fibres of the heart become sclerosed and weak, and thus the fibres when called upon for extra work are unable to respond. This irritates the spinal cord and the nerves leading through that level of the spinal cord, and these give a sensation of pain. All cardiac pain is of this nature. The heart itself is insensitive, just as the intestines are insensitive. The pain is thus a reflex.

In the first example of angina described the nature of the trouble was believed to be intestinal putrefaction. He was put upon a few-protein diet with castor oil at regular intervals. He also took milk sugar because milk sugar encourages the development of the lactic acid bacillus that is unfavourable to putrefaction. He was kept out of doors and made to exercise as much as his pain would allow him. Out-of-door exercise is the best treatment for a weak heart muscle after it has been restored to the point where it is not necessary for the person to remain in bed.

All through the study of cardiovascular disease we find these two elements to consider—rest and exercise. First comes rest and then exercise. The point where the rest must end and the exercise begin has to be decided as a matter of personal judgment. It gets to be rather a matter of instinct. I see some people and I tell them, "You must get up and go out." But I tell others, "You must go home and go to bed."

A man came to my office one day, an Englishman, and he told me that at one time he had been a champion boxer in the British Army in India. He had developed arterio-sclerosis with an aortic lesion, and suffered attacks of

suffocation at night, and his doctor had to give him large doses of morphine. He had the degenerated heart muscle of an old athlete—one of the hardest things with which we have to deal. I told that man, unless he wanted to die, to go home and go to bed, because his heart muscle had got beyond the point where exercise would restore it.

On the other hand, a great many people are at the point where they need exercise, and proper balancing of rest and exercise has a good deal to do with the management of the disease.

I told the first man with angina that he could exercise up to the point of discomfort, and that point got farther and farther off as time went on. Now he is a great advocate of exercise. He walks from his home to the court where he is employed, and every Sunday walks nearly all day, and has no attacks of pain. Here is a man cured by hygienic means.

The other condition, in the man from Pennsylvania, was the more severe of the two. He had more treatment and his disease was more advanced, but even at the very first he got some help. Realizing that the reason of the pain coming on as soon as he began anything was found in the extra work that the heart muscle had to do, because the first effect of exercise is slightly to raise blood pressure, I supplied him with some granules of 1/225th of a grain of nitroglycerin, and said: "Whenever you want to do anything, take one of these pills, because the nitroglycerin will cause a temporary relaxation of the blood vessels and so prevent this slight raising of blood pressure that comes with all exertion, and thus keep you from having the pain." This man had taken nitroglycerin, but he had never taken it that way—before exercise as a preventive. He told me that one night, when he was going to the theatre with his wife, she proposed walking. He took his nitroglycerin and walked a distance of ten blocks. He also said that whenever he felt the slightest tendency to pain he took a tablet, with a consequent decrease of suffering. This may be attributed to this little therapeutic manœuvre.

It is important in cardiac pain to relieve it if you can,

because unrelieved pain becomes habitual. The more pain of this kind a person has, the more he is apt to have. This is true, because the pain has its origin in the spinal cord from irritation. If people can go a good while without pain, they are less apt to have what is called the "pain habit."

I told this man we would have to investigate his chemical condition to see whether he had intestinal putrefaction. Then I put him on a course of treatment to improve his heart muscle. First he went to bed for a couple of weeks and took a course of Nauheim baths and exercises. These, properly given, are a great advantage. They have a bad reputation in angina pectoris, because persons whose heart muscles are badly damaged very often die suddenly. The Nauheim treatment when given injudiciously raises blood pressure and precipitates a fatal termination sooner than otherwise in angina pectoris; but properly given, with rest and a suitable diet, it can cause a good deal of improvement.

I had an old lady under my care a few years ago from Michigan who was one of the worst sufferers from cardiac pain that I have ever seen; one attack followed another all the time. In desperation, because everything else failed, I gave her a course of Nauheim baths and exercises, and she received a great deal of benefit. She was one of the most grateful people I have ever seen, because from that time on, following out certain hygienic rules we laid down, she lived a life of comparative comfort, and only had an attack once in a while.

The treatment of heart disease by physical means has not much reputation in these severe anginas. It is not because the treatment is not proper when suitably supervised, but it is because the task is too difficult.

The close relationship between a disordered chemistry of the body and a severe attack of angina pectoris in a man who was relieved of symptoms by a regimen is well illustrated in Mr. C., referred to me by Dr. Trenchard-Wood, of Staten Island. He was a gentleman, seventy-four years of age, who had enjoyed good and vigorous health. He had never had

any severe illness, except a nervous breakdown in the year of the Centennial of the Declaration of Independence.

He was a short, stout man weighing 160 pounds, blonde complexion and blue eyes. He said that his father had lived to the age of seventy-five and his mother to thirty-eight, and a great-grandfather to eighty-six. His wife was living and well, and he had one boy twenty years of age.

Five weeks before I first saw him he had an attack characterized by a very great pain in his left arm and shoulder, with shortness of breath. Following this he had been put to bed and had made a gradual recovery, but he suffered from insomnia on account of great nervousness at night, and shortness of breath on exertion. He was being fed up on eggs, meat and soups with the idea of restoring his strength, but his breathing and feeling of depression, he said, were becoming constantly worse.

On examination he was found to have a blowing systolic murmur over the base and also over the mitral area, the heart being somewhat hypertrophied. The blood pressure was 240 mm. Hg; hæmoglobin, 90; no œdema, and he was manifestly short of breath.

He was told to take a full dose of castor oil, and was put upon a few-protein diet; he was also recommended to take outdoor exercise. On account of his age it was not considered best to be too strict, so he was allowed beef once a day.

Two months later his tongue was found to be badly coated, in spite of the fact that he had taken castor oil once in eight days. Chicken was substituted for beef in the belief that he had a sensitiveness to beef. After this his tongue cleared up.

By this time he had become educated to his regimen, and he adhered pretty closely to it, taking sufficient outdoor exercise.

A re-examination for the purposes of this book, six months after his attack of angina, showed him in almost perfect condition for his age, and he was sticking religiously to his diet, his exercise and his castor oil.

The attack of angina was subsequent to a residence in a boarding-house at the seashore, where he had unduly satisfied his appetite with a multiplicity of protein foods.

The improvement in his general condition and feeling would have to be seen to be appreciated. There has been no indication of any return of his angina, which must have been a transient phenomenon in connection with the ingestion of some special protein to which he was particularly sensitive.

Pain or discomfort in the chest is an almost constant accompaniment of arteriosclerosis in all its stages. I believe it to be explained by the influence on the heart of the same agent as is causing the general circulatory disorder.

This discomfort can be traced in gradations from the slightest discomfort to the most severe typical attack of angina pectoris, and the principles of treatment for relieving slight symptoms are the same as must be employed in a modified degree for the symptom in its most complete development.

The question is often asked, What are the cardinal symptoms of arteriosclerosis? In part of an answer—it can be said with truth that præcordial discomfort is rarely absent.

Many examples come to mind of patients relieved of præcordial pain by measures directed against the development of arteriosclerosis. Often the slightest discomforts are the slowest to yield.

With regard to the coronary arteries as the supposed usual cause of cardiac pain, it may be said that after poison damage of the arteries has proceeded a long way, then damage through impaired circulation begins; but to explain all changes in organs by defective blood supply is to ignore the susceptibility of the organs to damage from the same poison as affects the arteries. Early toxic cardiac pain, that is so familiar in auto-intoxication, occurs before arteriosclerosis of the coronary arteries can possibly be blamed.

XI

ATAXIA, VERTIGO AND DISTURBANCES OF SENSATION

Ataxia and vertigo are very common in arteriosclerosis. Difficulties in locomotion and balancing are not so marked as in locomotor ataxia or organic disease of the semicircular canal, but they form very annoying complications in some persons, and the more definite conditions are excluded only by the study of each individual.

However, the treatment of the arteriosclerosis often relieves these sufferers in a surprising manner, throwing light upon the nature of the affection.

A lady was referred to me by Dr. William Seaman Bainbridge, and presented herself complaining of dizziness which kept her in bed for a week at a time. She had a feeling as if she was drawn backwards; she was nauseated when sitting up, and also complained of the rotation of objects when looking at them. She was seventy years of age, a practising physician, of medium height, blonde complexion weight 120 pounds. All her life she had slept well. She had been in the habit of using salines for the regulation of the bowels. The general health had always been good. She was the mother of two healthy children, who had reached the ages of forty and thirty-seven years. There had been no severe illness, but she had been successfully operated on for impending glaucoma in the year previous. There was no efect of vision at the time of examination. There was no trouble with the ears, except that seventeen years before she had had an attack of acute inflammation. Nearly a year previous to her coming to me she had been in

an accident in which she suffered a compound fracture of the arm that necessitated prolonged surgical treatment.

Examination showed a poorly nourished woman, apparently seventy years of age, with general arteriosclerosis of a mild degree of development; blood pressure, 118 mm. Hg; hæmoglobin, more than 100 per cent.; heart sounds of fair quality; the chief complaint was the vertigo and sense of exhaustion.

Mrs. M. had treated herself on the theory that she was suffering from nervous exhaustion, and had believed the vertigo to be due to disease of the semicircular canal, and had been eating a variety of protein food, with tonics and salines.

The salines were stopped, the diet was reduced to a single protein, and out-of-door exercise commanded. Castor oil was ordered, and no other medicine. On this regimen the attacks of vertigo became fewer and fewer, the hæmoglobin was carefully watched, and at the end of six months she reported that for the three months previous she had been free from attacks.

An example of disturbances of sensation was Mr. A., referred to me, in January 1911, by Dr. Joseph B. Bissell. He was a tall, spare blonde gentleman, a lawyer by profession, and of high mentality. His father died of pneumonia at fifty-five, and his mother in childbirth. He had one sister living and well, and, though his immediate parents had not reached old age, there was a family history of long life. He enjoyed good health up to within a year of the onset of his illness, when he began to suffer from great depression. He had always been a heavy eater, and had used large quantities of whisky. He complained of shortness of breath, gastric discomfort, insomnia, palpitation and inability to concentrate on work. He had also been told that he had a high blood pressure. The urine was of low specific gravity, contained a trace of albumin, hyaline and granular casts, and gave a very marked reaction for indican. His diet was found to contain an excess of protein food. He had been eating meat three times a day, with eggs, fish, soup and made-up dishes of all kinds. He suffered from

marked disturbances of sensation of the left half of the body without paralysis.

On a strict regimen Mr. A. made a good recovery.

At the menopause, nervous symptoms in arteriosclerosis are greatly exaggerated. While arteriosclerosis is common in men, the most frightful suffering from this cause often occurs in women, and every physician who has had to deal with a certain type of arteriosclerosis occurring between the ages of forty-three to sixty-three in women will acknowledge the importance of this group.

This type is characterized by very high blood pressure 190 to 260 mm. Hg, horrible subjective nervous symptoms, attacks of angina and head symptoms in endless variety. The condition is often secondary to attacks of acute inflammation of the kidney earlier in life, perhaps during a pregnancy, and seems to have a predilection to occur in women of particularly robust constitution, and who have a tendency to be stout.

There is often found a peculiar hardness of the tissues. This type of disease has long been recognized in medical literature under various names. The existence of high blood pressure, while previously suspected, has only been proved since the introduction of the sphygmomanometer.

By some the condition is considered purely a kidney condition. Of course, there is a well-marked kidney lesion, as shown by albumin and casts, but the abnormal pressure is the most prominent feature. That there is some definite relationship between the functions of the uterus and this disease is shown by the relief of symptoms upon an occasional return of menstruation and the fact of the very considerable relief of all symptoms that follows even a small phlebotomy.

The treatment of this condition has baffled some of the best physicians of all times; certainly sedatives do not give satisfactory results. The intense nervousness makes rest almost impossible. Arbitrary reduction of blood pressure is followed by signs of decompensation, as evidenced by pulmonary congestion.

The danger of accidents in the form of hæmorrhage is always imminent. Persons of this type I have treated very often by phlebotomy of a quart of blood, by a few-protein diet and forced out-of-door exercise. Three were very much improved and the blood pressure somewhat reduced. People of this type are particularly liable to attacks of claudication causing temporary paralysis or par-æsthesia, and the conditions being so ripe for hæmorrhage it is sometimes hard to be sure at first whether this has taken place or not.

No one who will stop to think of the observable influence of mental emotion on the circulation can doubt the effect of worry on the arteries. The pallor that goes with intense mental tension means that the peripheral blood vessels are contracted and that the vessels of the brain are correspondingly dilated.

The number of people who develop arteriosclerosis through mental conditions alone is probably small, but many times during the year we see the development of symptoms in those who have previously been without symptoms from the effect of this cause on the heart and blood vessels.

Arteriosclerosis is rarely due to one cause. It is due to several coming in succession or simultaneously. Worry is one of the commonest accessory causes, and immediately precedes the final passage of the trouble from a symptomless disease to one of which the person is conscious. Then vertigo and disturbance of balance and sensation are apt to appear.

XII

THE LIVER IN ARTERIOSCLEROSIS

A MAN prominent in the life insurance world has written me :—

"You ask my personal opinion as to the philosophy of the development of the disease, and how much the prognosis may be influenced and by what regimen. I hesitate about giving you this; I do not feel that I know enough about the subject to be quoted, and what I say here is for what it is worth, and for your personal delectation, if you can get any out of it.

"I believe that high blood pressure and arteriosclerosis are as a rule due to one of two causes: (1) To the breaking down of the liver functions with respect to albuminoid foods; or, (2) intestinal toxæmia; or to a combination of these.

"I think that the food that the liver metabolizes with the greatest difficulty is the animal proteid, and that when the liver function begins to break down, whether that failure shows itself by an albuminuria, a glycosuria, or high blood pressure, it is due fundamentally to albuminoid insufficiency. I have frequently seen glycosuria clearly attributable to excess of meat foods. I saw it so often that I became convinced of it; so much so that, if I were again in the practice of medicine and had glycosuria to deal with, I should certainly try the experiment of cutting out the animal albumins.

"However all this may be, my impression is that you are more apt to get high blood pressure with little arteriosclerosis in the cases due to failure of liver metabolism; and more apt to get the sclerosis with slight or only secondary high tension with intestinal toxæmia.

"This, in a very crude way, represents my impressions on the subject, which, as I have already said, I give you for what they are worth."

Referring to the opinion of this gentleman with regard to the relation of the liver to arteriosclerosis, it does not seem to be far different from my own theory so frequently referred to in this book,—that particular proteins, or the products of particular proteins, are the things at fault, but that they do not become active until the body has become sensitive to them through some change in itself. I feel disposed to extend this sensitiveness to the body cells in general, rather than to put the burden of blame entirely upon the liver, though it is easy to conceive that if the detoxicating function of the liver is sufficiently perfect, the cellular elements of the rest of the body may be spared from a test of their sensitiveness.

As a clinical matter the well-being of a person suffering from arteriosclerosis in all its stages is closely dependent upon the functional integrity of the liver, and, as the insurance man says, very high blood pressures are found associated with evident trouble in the region of the liver. Elsewhere in the book is an account given of several persons who suffered from blood pressures of up to 300 mm. Hg, who were subjected to phlebotomy to rescue them from a situation of great danger. In all these there was a definite complaint of a special discomfort in the region of the liver that was distinctly benefited by phlebotomy.

The large venous circulation in the abdomen is a great collector of the crude chemical products of digestion. A plethoric condition often results that has been frequently the subject of medical attention but is never sufficiently remembered. The resulting hypertension in the portal system, which was well named by the ancients "abdominal plethora," leads to the rapid generation of poisons, which, escaping through the liver, reach the heart and lungs and give rise to distress, which is referred to the heart or lungs and often blamed on the stomach.

For many years I have taught that much of the so-called

reflex relation between the heart and the stomach was a myth and that the palpitation and a great deal of the asthma occurring under like circumstances are due to a direct poison to the heart or lungs from the chemical products of metabolism. This is so definitely illustrated in the more gradually developed and also in the more serious anginas and in the permanent damage to the auricle, that there can be no reason for attributing temporary disturbances to reflex action. The latter is entirely inadequate to explain more permanent damage. In the evident fact that this same condition of poor hygiene of the liver and its concomitant circulation in spreading noxious products through the system may also cause many evils, we must not forget that our main topic is arteriosclerosis.

In the liver or splanchnic type of arteriosclerosis there is a characteristic pallor of the surface of the body. The sufferer has practically been bled into his own abdomen, and one of the most striking and satisfactory results of treatment under the circumstances is to observe the relaxation of the spasm of the peripheral blood vessels with a return of colour to the skin and the relief of the tenseness and hardness of the abdomen.

In this connection it is well to recall the fact that this condition of the liver never develops from age alone, nor, indeed, does arteriosclerosis, the disease.

There is no disease characterized by definite changes in a blood vessel that corresponds with the conditions which come to middle-aged and older human beings as a matter of involution. Pathologists must of necessity be localists in that the microscope can be focused only upon one small place at a time. The pathologist may at the same time be a great diagnostician, but few pathologists have ever been great therapeutists. The fact to be remembered is, that in this condition structural changes follow chemical and physiologic vice and do not originate from some mysterious source and cause, or as a matter of age effects.

However much discussion there may be as to the lesions of arteriosclerosis, an extensive experience in addressing medical societies and taking part in discussions on this subject

among physicians shows that, except as they are influenced by the bugbear of structural change, there is very little difference of fundamental opinion that connects the toxic cause with the disease and gives full recognition to the importance of the integrity of the renal function.

To the physician in actual practice, the problem is to regulate the functions so that the person who has come to him for treatment may enjoy a comfortable life and be granted the ten, fifteen or more years of life that can be added by care to a person with advanced arteriosclerosis.

Far better is the human body with advanced structural changes whose organs have been made to behave well than a much sounder body whose parts are in disorder and liable to cessation of function. There is a specific advantage in concentrating the attention on the liver in that popular opinion grants to the medical profession the credit of being able to regulate its functions, while the same opinion acknowledges grudgingly that physicians can prolong life when the arteries are hardened or the heart diseased. The public will employ the physician who will administer drugs freely, because they deem that is what the physician is for; but in their inmost hearts they respect most highly the one who insists upon the importance of diet and compels obedience, who knows their failings of hygiene and insists upon correction and who withholds the comforting dose for their ultimate good.

There is a subconscious knowledge on the part of sick people of the real location of their trouble which affords a most interesting matter of investigation, and is not to be ignored as an element in a complete diagnosis.

The farther advanced the development of arteriosclerosis, the surer the sufferer is to locate the trouble in the abdomen, —at first in the region of the liver and at last in the lower bowel.

Hardly any very old person succumbs to arteriosclerosis in whose last days all earthly worries are not concentrated on the function of the lower bowel with a profound feeling that everything depends upon the liver.

Physicians should not neglect the outside light that can

be thrown upon their work by those whose perspective is not shortened by the closeness of the problem of the care of the sick, so I value particularly the concurrence in my own views of one whose occupation is that of director of the medical interests of a great insurance company with financial relations larger than some governments. In general, such a company cannot afford to be wrong in any of its theories, and its officers are trained to precise observation and the necessity of correct conclusion.

In this connection the movement at the present time on the part of insurance companies for improving the hygiene of the country, believing that in this way their own business can be made more satisfactory, is of much interest. Among the members of the medical staff of life insurance companies I have found a more intelligent interest in the problems of arteriosclerosis than almost anywhere else.

XIII

THINGS TO BE AVOIDED IN ARTERIOSCLEROSIS

The abuse of saline laxatives in arteriosclerosis is to me a real factor in the life-history of many of those who come under observation. The disease is of such slow development and long duration that one's conception must be a composite picture drawn from many examples. One of the most significant facts confirming my opinion is that a Carlsbad prospectus, to which I never heard any objection on the part of those connected with that place, states that well-developed cardiovascular disease is not benefited by the treatment.

Disastrous break-downs following an active cure of this kind are not at all uncommon in advanced arteriosclerosis. They occur about a fortnight after the cure has been discontinued. The philosophy of this has been to me a matter of much speculation, and I have thought of several explanations. One is, that the osmotic function of the intestines being disturbed there is later an absorption of foreign proteins into the blood, causing poisoning; or, to mention a theory which does not seem to me as probable as it did at one time, but may be true, during the active catharsis there may be a suspension of a chronic intestinal putrefaction which, on the recurrence of stagnation when the cure is stopped, becomes more active than ever.

The same thing may be said of salines as of alcohol and many other things, that because they can be abused is no good reason that they should not be properly used.

On the other hand, there are a hundred other laxative combinations and drugs for choice. This is not true of alcohol, for which there is no substitute in its particular

place. Castor oil is safe and so effective that it is worth while to overcome the universal prejudice against its taste by such artifices of persuasion and pharmacy as are available.

May I be forgiven if I acknowledge the dread of antagonizing many good friends in different parts of the world as preventing me from speaking, except after mature deliberation, of my deeper convictions as to waters with large mineral content.

In the early stages, waters with very small mineral content may be allowed, but a cure entailing hypercatharsis in a sufferer from advanced arteriosclerosis is so dangerous that experienced physicians at cures of this character warn these people off the premises.

The functions of the intestines in these persons are too important to be thoughtlessly put upon such a strain as attends the abuse of purgative mineral waters. During the continuation of the purgation nothing happens, but two or three weeks later the specialist in cardiovascular disease finds himself in command, and has all he can do to tide the victim over a serious attack of auto-intoxication with a cardiovascular crisis. I have seen an intractable fibrillation of the auricle originate in such an attack following a reduction cure.

The use of salines has become so general that the public is sure to use them more or less without advice. They cost so trifling a sum of money by the barrel and bring so considerable a price by the bottle that they will ever make a favourite field of speculation. The benefit of visits to springs has always been so great that it is a dream of the ages to bottle the benefit and give it to suffering humanity at home. But however strong the bottle or tight the cork, the virtues escape and remain at the springs only for those who, giving up their business, sacrificing the comfort of their own homes and the ministrations of their own cooks, take a journey to the springs.

To the sufferer from arteriosclerosis the purer the water the greater the benefit. The exception to this is in the use of carbonated saline baths for a moderate number of sufferers who have been carefully examined with regard to the relative

development of the renal element of the disease and who are skilfully supervised during the treatment.

In this connection I want to quote freely from a paper of Professor J. M. Groedel[1]:—

"Whereas formerly the various forms of Bright's disease were treated at different spas (in addition to dietetic treatment) by the use of drinking waters alone, the bath cure has been more recently adopted. Some authorities, indeed, have entirely abandoned the use of mineral drinking waters. At the Seventeenth German Home Medical Congress, 1899, Professor Von Noorden (Frankfort) spoke very decidedly against their use. He recommends, in contradiction to Bamberger's teaching,—until then universally adopted,—a restriction in the amount of fluids consumed. Professor Ewald (Berlin) confirmed this opinion. Both experimentally and clinically Von Noorden had discovered that in cases of contracted kidney in the stage of comparative euphoria, as well as in the early stage of heart weakness, the elimination of the products of the metabolism was not influenced to any extent by a reduction in the amount of fluid taken in twenty-four hours down to about five-fourths of a litre a day. Also the secretion of albumin, judging by the actual daily quantity, was not materially affected by the increase or decrease in the amount of liquid taken. He observed in over thirty cases that, in the advanced stages of Bright's disease, when the action of the heart is nearly failing, a diminution of fluid proves beneficial. He also recommends in the early stages of the disease, though more as a prophylactic, a reduction in the quantity of fluid usually consumed by patients with renal disease. The majority of patients in the early stages of contracted kidney may imbibe a great quantity of fluid, as in the milk-cure, or treatment by mineral waters, without specific injury. Nevertheless, in some cases Von Noorden observed an enlargement and weakening of the heart immediately after and in connection with a course of mineral water, which were removed by making a decided restriction in the amount

[1] "Treatment of Chronic Nephritis by Mineral Drinking Waters and Mineral Baths," *Practitioner*, December 1901.

of fluid taken. His experience relates chiefly to contracted kidney, but he remarks also that in parenchymatous nephritis it proves very beneficial to depart, under certain circumstances, from the customary prescription of copious water-drinking."

Other authorities take a somewhat different standpoint. Professor von Ziemssen[1] (Munich) says:—

"In cases of chronic parenchymatous nephritis a copious flushing of the kidneys results, according to Bamberger, in a freer secretion of excremental substances. Therefore in most cases of nephritis the supply of fluid should not be curtailed; on the other hand, the amount must not be regulated by the patient's thirst. It is necessary to ascertain by experience what quantity of fluid over and above 3½ pints proves most beneficial to the patient's general health and the quality of the renal secretions. A treatment by weakly mineralized alkaline water is quite permissible, but not by muriated or alkaline sulphated springs." Von Ziemssen continues: "In cases of contracted kidney a restriction in the amount of fluids consumed daily is sometimes desirable in view of the danger arising from an excessive increase of blood pressure in the arterial system, which must necessarily be the result of overloading the circulation with a great quantity of fluid. Even greater stress must be laid upon the restriction of fluids if the patient is in an advanced stage of the disease, with a corresponding degree of arteriosclerosis and hypertrophy of the heart and consequently with a permanently high blood pressure.

"As to my own opinion, I may state that I never see any distinct gain result from a course of mineral drinking waters in any form of Bright's disease. But in several cases I observed, like Professor von Noorden, that the condition of the heart became critical during a drinking 'cure.' Also an excessive quantity of milk administered to patients was in several cases I observed injurious to the heart. Nevertheless I do not agree with Professor von Noorden as to the

[1] Von Leyden's "Handbuch der Ernahrungstherapie und Diaetetik," vol. ii. 2nd Part, 1899.

'prophylactic' restriction of fluid food. Though he may be right in saying that the elimination of oxidized waste is independent of the amount of fluid ingested, I think it may not be indifferent to the renal vessels, the uriniferous tubules, and the parenchyma, whether the urine passes more concentrated or less. Therefore a moderated milk 'cure' as well as the drinking of weak alkaline and muriated alkaline waters to a certain limit are indicated, the waters, moreover, for their slightly diuretic effect. But I never allow patients with Bright's disease to take such a quantity of fluid nourishment as others often prescribe. It is a matter of course that eight pints or more per diem, an amount not seldom consumed, must constitute a serious addition to the work imposed upon the kidneys, and especially upon the heart.

"As soon as a considerable insufficiency of the heart makes its appearance, I think it decidedly useful to make a marked reduction in the amount of fluid ingested. But in doing so I am always guided by the same maxim which I follow when dealing with other kinds of disordered circulations: I order an exact daily measuring of the quantity taken, and also the quantity cast off. From this I regulate the use of water and fluid nourishment. The average quantity is somewhat more or less than two pints. Professor Ewald (Berlin) recommends the same method."

This does not mean that persons with arteriosclerosis must not go to mineral springs. On the contrary, often enough, the regimen and other forms of treatment that these sick people need are only to be found where attention is centred on those whose vocation for the time being is the search for health. Sometimes it may even be better for the arteriosclerotic to risk the waters for the sake of the other benefits. The great desideratum of all "cures" is wise supervision.

Many of those sufferers need treatment and need it badly, and if belief in the magic properties of some spring is necessary to draw them to the cure, I am the last one in the world to wish to destroy any faith that is necessary to lead them to a

place where a cure can be obtained. This is a very delicate matter. It involves the intangible philosophy and psychology of success in the treatment of disease. People demand specifics for the cure of disease, and, failing that, often go untreated. The man who seeks the gold buried at the end of the rainbow at least gets exercise. I know a man who cures arteriosclerosis with electricity, plus diet and a strict regimen. The electricity draws the patients, and the diet, exercise and general good advice do the rest. One of my earliest experiences with this kind of thing was when I was a medical student in seeing an anæmic young girl go to a psychic healer, who, after holding her hand and shutting her eyes, gave her iron and laxative pills. Physicians are not always justified in dispelling the illusions that are necessary to the cure of the sick, but it is their duty to safeguard this element of human nature so that harm may not come.

In choosing a health resort I would rather have an analysis of the character and intellect of the men in charge than a knowledge of the chemistry of the waters.

In a paper of my own I have said of this matter:—

"Every resort where any particular disease is handled always has some special form of treatment that characterizes that place, and that is the elemental idea that occurs to people when they speak of the place for the disease. The least possible consideration will lead to the recognition of the fact, that the elemental treatment in any place where disease is treated is not the whole cause of the improvement of the patient.

"The German word 'Kur' sounds very much like the English word 'cure,' but in Germany, when they speak of a patient taking a cure, they do not mean that the patient is undergoing a course of treatment which necessarily leads to the removal of the disease. What the German cure means (and in Germany, and in Europe in general, a great many people take a cure every year at some time or another) is a course of treatment and a period spent under changed conditions, by which the patient who is suffering from, or is threatened with, some disease is put in the best possible

condition. It is quite possible that the disease may be removed, but whether it is or not, if the patient undergoes a course of treatment, and a period of life under different conditions which are designed to improve his condition, that is a 'cure.' The patient has taken a cure, and has taken a successful cure, even though the disease has not been completely removed. This conception of the word 'cure' is very important, and we need to learn it in this country.

"The American people need to be taught that everyone, certainly persons past middle life, should give up a certain time every year during which they are to be put in the best possible condition. A vacation is supposed to do this, but that is a random affair, and you can do almost anything on a vacation. People quite frequently come back in worse shape from their vacations than when they started, because of unsuitable hygiene, sometimes dissipations, and so on, that they are not able to stand.

"In Europe people combine a vacation with a cure and obtain great benefit, and the fact that this is generally done has led to the great development of cure resorts.

"You can call them health resorts, or, as the English call them, spas; we often call them springs in America; and Germans call them Kur resorts.

"Another element that is not to be despised is the moral atmosphere of the place. People do not go to a place unless they have faith in it. When you get thousands of people to come to a place each year—all with the idea of getting benefit—there is an inevitable air of hopefulness. The people believe that they are going to get well, and the general spirit is that of optimism. The people always speak of the improvement, and seldom of anything going wrong. If the organization of the place is complete, all disagreeable things are kept out of sight; this has something to do with the success of the place. Of course, you cannot get so many people together in one place—some of them dangerously ill—without an occasional accident. This idea of maintaining a cheerful mental tenor is a very important and commendable one, and is really accomplished in a very remarkable manner. This is important

in the treatment of heart disease, and we should imitate it all we can in our work. The heart patient must be kept optimistic because it conduces to a cure.

"A man who has learned the ultimate principles of the treatment of heart disease and has sufficient strength of mind and enough control, can get just as good results right here in New York City as can be obtained at a cure resort, but, on account of the absence of the natural baths, of the air, of the diet and proper kind of exercise, and the atmosphere of hopefulness, the physician must exercise an iron control over his patient, and he must have implicit faith that he is going to get results. Given these attributes, he can cure heart cases just as well in New York.

"The baths alone without the regimen are often not worth taking. In hotels and water cures that are not under the control of people who understand heart disease, bath-givers often lay out the baths as a specific, and make such great claims for them that the patient thinks as long as he takes the bath that is all that is necessary. Then the baths may be given stronger than is wise, and the exercises too strenuously, because the patient demands his money's worth.

"I think we ought to have a place in America that is not too fashionable and not too much devoted to money-making. It ought to be under the control of a man who is devoted to that particular kind of work, and it ought to be within easy reach of New York, so that the patient could be more or less under the control of his own doctor.

"Treatment is essentially an art. It is a bringing together of a whole lot of things to a definite end, and is not necessarily founded and conducted on 'scientific principles'—if by 'scientific principles' we mean 'rule of thumb' principles.

"The whole subject merits more attention than it has received, and we must not accept as final the word so often heard, that Americans want a prescription and not a regimen —that dieting is next to impossible, and exercise beyond their reach. Success in arteriosclerosis can only be through the education and re-education of the sufferer. I must acknowledge that this is laborious in the extreme, but I have

been more than repaid by results and the appreciation of patients of intelligence; as for others, they have often considered the cure methods too severe, and resumed the path to degeneration under palliative treatment."

The question of tobacco in arteriosclerosis still remains a matter on which there is much difference of opinion. All agree that it is foolish to use tobacco in well-developed arteriosclerosis, and that it should be strictly controlled in all. The simplest laboratory experiment shows that tobacco is a strong drug capable of raising blood pressure. If anyone doubts this, all that is necessary is to measure the blood pressure of an average person when tobacco-free and after smoking a strong cigar; of course, if the man is not accustomed to tobacco and nausea should supervene, this will more than overcome the tenser effect of nicotine, and in chronic tobacco poisoning the pressure is low.

With regard to tobacco there has been much misconception, or else there would not be such diversity of opinion.

The author does not believe that tobacco is a usual cause of arteriosclerosis. In other words, a person not exposed to any other cause would not ordinarily develop arteriosclerosis from this single agent, no matter how much it might be used. On the other hand, the author is thoroughly convinced and absolutely sure that in those who have arteriosclerosis in the slightest degree, tobacco is a disadvantage and sometimes a great danger. It may be a profound poison. The fact that it is sometimes almost impossible to persuade a victim of the habit to give it up is like other poisons.

Some time ago I saw a lawyer with arteriosclerosis in a very advanced stage. His blood pressure was running up to 220 mm. Hg, and he had many accompanying miseries. He was unable to go without his six or eight cigars a day. I had no reason to suppose that in this instance tobacco was the cause of the disease, but as an habitual pressor poison in a man whose condition demanded a very high blood pressure for the accomplishment of function, the drug was terribly missed when it was withdrawn. It is like any other

stimulant habit. The continuation of tobacco in this instance makes the outlook very serious.

If what I have said is true, it would be fair to place tobacco not as a cause of arteriosclerosis, but as a serious complication.

The belief that an exaggeration of function alone can cause serious degeneration of organs is very hard to prove until a good many instances can be observed in which this has happened without an accompanying tissue poison.

This certainly cannot be found in arteriosclerosis, because the very strain that will cause a nervous high blood pressure will at the same time upset the chemistry of the body and lead to sensitiveness to proteins, and the same man who disturbs the functions of the circulatory organs with tobacco indulges in other excesses with a like result—a disturbance of chemical relations.

As a matter of fact, we can observe a great many excessive smokers who do escape arteriosclerosis and live to a great and healthy age. The converse of our proposition is then true.

Among the things to be avoided all will look to see alcohol mentioned, and indeed it logically belongs to this chapter.

It is a matter upon which people seldom really seek advice, but in case some such should read this I will say that the principle upon which the question must be decided pertains in a great measure to the individual person. He who has abused alcohol must forgo its use in the presence of disease of the blood vessels, while the use of a good wine in moderation is not by any means harmful to those affected. As a practical matter, it is easier to give up alcohol entirely when so ordered than to use it in moderation, if it has become a habit. As a matter of general policy, it is much better for a practising physician not to order alcohol at all. Many people are so ready to take advantage of the slightest advice of this kind that it is extremely dangerous.

The distinction must be made between the healthy person and the person who has developed a sensitiveness that is

liable to put him in the category of arteriosclerotics. When a physician orders a strict diet and a troublesome regimen for someone who applies for relief of tightness in the chest, dizziness on stooping, a feeling of seediness, insomnia, headaches, somnolence after meals, neuralgia, sciatica or other signs in a person who is found to be suffering from arteriosclerosis, he often reciprocates by a question. He says, "Doctor, do you live on this diet and carry out this regimen?" and the logical answer is given that the doctor himself is not suffering from arteriosclerosis and does not intend to if systematic exercise and suitable vacations and proper philosophy of life can prevent it.

The art of treatment in arteriosclerosis must of necessity involve the withholding of many things in addition to those referred to in this chapter, but there is a limit to the physician's power that is soon reached. For this reason it is necessary to know the relative importance of things, that one's authority may not be wasted on non-essentials. A study of character must be made. Sometimes a conflict over a non-essential matter, such as an insignificant amount of alcohol or a single daily cigar, may create a situation preventing the control of the vital matter of diet, exercise, essential medication and that besetting sin of so many, worry.

XIV

OPINIONS OF AMERICAN PHYSICIANS ON ARTERIOSCLEROSIS

In reviewing the literature of arteriosclerosis, such wide diversity of opinion appeared that it seemed to me desirable to get an informal expression of the current opinion of some of my friends in the profession whom I knew to be interested in this subject. I asked the following questions:—

"Have you a reprint or can you give me the reference to anything you have written on arteriosclerosis? I am preparing a small monograph for the Oxford University Press, and I would like to refer to your views. I should value very much your personal opinion as to the philosophy of the development of the disease and how much the outcome may be influenced and by what regimen."

My valued friend and former teacher, Dr. George L. Peabody, sent me a reprint of his résumé of "The Relation between Arterial Disease and Visceral Changes," a paper which he read before the Association of American Physicians in September 1891.[1]

He reviews carefully the literature of the pathology up to that time. He describes cardiosclerosis under the name fibrous myocarditis, thus anticipating the work of recent years; and he says that angina pectoris should be produced by coronary sclerosis, and continues: "In passing, it may be proper to say that this is not the only cause of that serious and painful disease."

He says: "Hutchinson[2] describes a case of senile oblitera-

[1] "The Relation between Arterial Disease and Visceral Changes," published in *Boston Medical and Surgical Journal*, October 29 and November 5, 1891.

[2] *Archives of Surgery*, London, 1890–91, ii. p. 54.

tion of temporal arteries in a man eighty-nine years of age apparently due to arteriosclerosis. The vessels were like hard cords. While the process was going on, there were much pain and tenderness in them, both of which disappeared when it became complete. There was no gangrene nor any other symptoms than those mentioned."

Strangely enough, the next answer was received from Dr. Harlow Brooks,[1] of New York, who sent me a reprint of his interesting article on the same subject, published fifteen years later than Dr. Peabody's. This paper is well worth study, as is also his article on "Modern Treatment of Arteriosclerosis,"[2] He also writes:—

"I have long been a student in regard to the etiology of arteriosclerosis. I confess myself very much confused by the apparent evidence which my clinical and pathological experience presents to me, but if I were forced into a corner and obliged to express myself, I think that I should subscribe to the two following factors being most frequently concerned in the production of arterial disease as it has appeared to me. First, I would be inclined to place in a large, but separate, class that caused by syphilis and other infections.

"As the most important factor in the production of arterial disease, I would place anxiety, worry and in general the stress of life—perhaps this is one reason at least why we never find the condition among wild mammals, living under anything like natural conditions.

"After this factor, or group of factors, I think that I should next consider errors of diet and over, as well as improper, alimentation, with their results."

Among the most brilliant thinkers of America is my friend, Dr. S. Solis-Cohen, of Philadelphia. While he tells me to look upon the notes he sends me as memoranda, and says, "Of course, you are familiar with everything here," I consider his letter so suggestive that I venture to repeat what he says.

[1] *Am. Journ. Med. Sc.*, Phila., May 1906, "A Preliminary Study of Visceral Arteriosclerosis."

[2] *International Clinics*, vol. iii. 21st series.

"My practice in my lectures is to divide it into two classes, each with subdivisions. These two main classes are 'normal' and 'pathologic.' I teach that the onset of normal hardening of the arteries should not occur until about three score and ten, and should not reach a high grade until five score, consequently what we see is usually pathologic to a certain extent. The onset of this minor pathologic (premature) hardening can be prevented by the hygienic life.

"The marked pathologic hardening I look upon as the result of infection or intoxication of one or another kind, frequently intoxication with food poisons, even in those who abstain from alcohol and nicotine, and who have not become infected with lues, etc. Furthermore, we have the toxins generated by the emotional and strenuous life; in the former instance to a certain degree by sympathetic derangement of visceral-glandular functions; in the latter instance by breaking down of tissues. I have pointed out somewhere (though I cannot lay my hand on the reference) that the thyroid system (by which I mean the thyroid gland and its accessories, including the thymus) constitutes the gland of youth, while the adrenal system constitutes the gland of age. Testes and ovaries are complementary or supplementary or auxiliary to the thyroid, but excess is one of the causes of arteriosclerosis, partly by preventing reabsorption through excessive discharge, and partly in other ways not clearly understood, perhaps of a sympathetic character, perhaps through an internal secretion, perhaps through a by-product, as the corpus luteum, etc. The balance between thyroid and adrenal (using these as types) constitutes health, and the derangement of this balance gives rise to various disturbances, from myxœdema and akromegaly to Graves' and Raynaud's phenomena.

"Specifically, I believe that adrenal secretion and pituitary (posterior) secretion tend to produce fibrosis of the arteries. I find a correlative proof in the value of iodine in treatment. It is true that the iodides, except in enormous doses, do not lower blood pressure in the normal individual, but blood pressure is a resultant of many factors, and is largely mis-

interpreted by ignoring one or another of these factors. Small doses of iodine compounds continued over long periods of time do hold fibrosis in check, and I have sometimes thought that the combination of iodine with thiosinamin even tended to produce recession; but this is beyond the scope of clinical demonstration.

"Arsenic from time to time is useful in the treatment of premature normal arteriosclerosis (if you understand what I mean by this somewhat paradoxical term). In the pathologic forms I have not seen much good from arsenic, but I have seen mild doses of mercurials from time to time do good (I do not mean in cases of lues only), and the nitrates also. Of the latter I prefer either the sodium compound,[1] erythrol tetranitrate [2] or mannitol hexanitrate [3] given in much smaller doses than usual; in fact, the minimum dose that seems to be followed by appreciable effect.

"Medication of any kind, however, must be intermittent, and the main dependence placed upon sane living, including dietetic regulations and due elimination, aided, if need be, by hydrotherapeutic procedures, or the use of light, heat, electricity, massage, exercises, etc., with avoidance (of course) of any discoverable special cause and proper treatment of any discoverable infection or intoxication."

Dr. Henry Koplik, of New York, writes me concerning arteriosclerosis in children. He says:—

"I have not written anything specific on arteriosclerosis, for the reason that in children this condition is of rare occurrence as an entity. It does occur, however, and then we see it accompanied by hypertrophy and dilatation of the heart. I have seen such cases ("Diseases of Infancy and Childhood," p. 79). I have also had two cases of sclerotic kidney accompanied by arteriosclerosis in young children. One of these cases was worked up by Dr. Libman from a case in my ward. I have also had a case of gangrene of the toes and fingers symmetrical due to arteriosclerosis. This was a recent case. I believe, in children, arteriosclerosis is of luetic origin, and when seen *in extenso* is a late mani-

[1] Gr. $\frac{1}{8}$ to gr. $\frac{1}{4}$. [2] Gr. $\frac{1}{32}$ to gr. $\frac{1}{8}$. [3] Gr. $\frac{1}{16}$ to gr. $\frac{1}{4}$.

festation and fatal. In the case of gangrene we failed to obtain a Wassermann reaction, but iodides improved the child into a recovery from gangrene. I doubt whether in childhood any other cause is active, unless we include alcohol as a cause of cirrhotic changes and in these cases such as Banti's I have felt, from seeing two cases, that syphilis was the underlying cause."

Dr. G. Frank Lydston, of Chicago, says :—

"I am afraid you will think me a 'dry tap,' but I'll give you my ideas, briefly; I regard arteriosclerosis as due to—

"1st. (In some cases) hereditary, faulty vessel structure.

"2nd. Vascular 'over-strain' long continued (hard labour) or acute over-strain frequently repeated (athletics).

"3rd. Toxæmias in variety, *e.g.* gout, rheumatism (*i.e.* the toxæmia underlying these disturbances), syphilis, alcohol, defective renal elimination. The relation of over-eating—especially of meats—will at once occur to you. The exanthemata. These conditions do not act perceptibly until senility—normal or premature—lends a hand. I suspect that gonorrhœa also hath its victims. Incidentally, I have seen some wonderful results from thiosinamin."

His suggestion of gonorrhœa as a cause of arteriosclerosis was very interesting to me, because, the very day his letter came, a gentleman called to see me who has very marked arteriosclerosis at an early age who gives the following history :—

He was thirty-five years of age, salesman by occupation; parents living and well, also one brother and three sisters. He had had no severe illness, but eight months before I first saw him he had a severe gonorrhœal infection. He was referred to me by Dr. Ramon Guiteras, a well-known specialist in this line of work, so that there was no question about the diagnosis, or the possibility of specific infection being overlooked.

After prolonged treatment the recovery from local bladder and prostatic conditions was complete, but the evidence of the development of arteriosclerosis was so definite that he was referred to me.

His arteries showed evidence of thickening, and he had discomfort in the region of his heart; blood pressure, 137 mm. Hg.

Under a strict regimen the condition has been held in check during the two years he has been under observation, but it is still perfectly evident to any careful examiner.

I have not often considered this infection as a cause of arteriosclerosis, but no doubt, bearing it in mind, other instances will appear, and I am indebted to Dr. Lydston for the suggestion. I see quite a number of examples of malignant endocarditis from this cause.

Dr. Frederick P. Henry, of Philadelphia, sends me, as representing his opinion, a reprint on "The Therapeutics of Cardiovascular Disease."[1] He says:—

"The subject of cardiovascular disease, which is practically identical with that of arteriosclerosis, is one of the most important that can engage the attention of the physician. It involves questions of anatomy and physiology, questions also of physics, dynamics and hydrostatics, rather than those of bacteriology; and is therefore pre-eminently a clinical question. If on its many sides it has a bacteriological facet, it has yet to be discovered. It is a disease from which every one is bound to suffer, in a greater or less degree, provided he live long enough, and yet, strictly speaking, it is not a disease of old age. The effect of old age in the etiology of arteriosclerosis may be illustrated by the popular saying with reference to this or that individual: "Give him rope enough and he will hang himself,"—the only difference lying in the fact that with regard to the disease in question, the analogous saying is applicable to all: Give him time enough and he will develop arteriosclerosis. And yet, I repeat, old age is not, *per se*, a cause of arteriosclerosis, as is proved by the observations of octogenarians and even centenarians whose arteries were perfectly healthy. A case in point is that of Madame Robineau, described by Metchnikoff in his recent work on

[1] Read, by invitation, at the Ninth Annual Meeting of the American Therapeutic Society. Published in *Monthly Cyclopædia and Medical Bulletin*, June, Issue 1908.

the prolongation of life. At the age of 105 she had retained her intelligence fully, her mind remained delicate and refined, and the goodness of her heart was touching. . . . The most remarkable circumstance was the absence of the sclerosis of the arteries!

"I have at present under my care a lady in her ninetieth year whose mental faculties, including memory, are in perfect preservation and whose palpable arteries show no signs of sclerosis. The absence of sclerosis of cerebral vessels may be inferred with considerable certainty from the state of the mental faculties. The man who at the age of seventy-eight writes brilliant novels and beautiful poems, may possibly have sclerosis of his radials, but it is practically certain that there is nothing the matter with the arteries of his brain.

"Another proof that age is not a true etiological factor is afforded by the fact that advanced arteriosclerosis has been observed in children, and even in the new-born. The rôle of age in the production of arteriosclerosis may be compared to that of one who is *particeps criminis*. It not only does not interfere with the nefarious work of microbes and toxins, but gives them the opportunity for its accomplishment.

"Among the generally accepted causes of arteriosclerosis are the following: prolonged physical exertion, intestinal toxins, lead, alcohol, tobacco, perhaps also tea and coffee, the infectious diseases, especially syphilis, and those diathetic diseases included by the French under the term 'arthritisme,' namely, obesity, gout, lipogenic, diabetes and lithiasis. As will be seen later when I come to discuss the question of treatment, the data furnished by the experimental pathologist are far from satisfactory.

"The etiological relationship of arterial hypertension to arteriosclerosis is a subject which must, of necessity, be carefully considered by every student of the disease. There is much to be said in favour of the theory that the various substances which I have mentioned as generally accepted causes of arteriosclerosis produce the disease through the agency of the hypertension to which they give rise. One of

the most important arguments in favour of this theory is derived from the well-known action of adrenalin. (1) This substance is the most powerful vaso-constrictor of which we have knowledge, and arteriosclerosis may be readily induced by its injection into the veins of an animal. (2) In a large percentage of cases of arteriosclerosis the adrenals have been found hypertrophied post-mortem.[1] (3) The removal of the thyroid and the suppression of the functions of the ovaries, both of these organs being hypotensive, are followed by arteriosclerosis, which is also seen, sometimes at an early age, in cases of myxœdema. Facts such as these have satisfied some of the most competent observers that hypertension is an essential cause of arteriosclerosis.

". . . Nevertheless, the question of diet is undoubtedly the most important in the treatment of arteriosclerosis, although it is one concerning which there are divergent opinions. All are agreed, however, that such substances as excite the heart and increase arterial tension should be entirely avoided or reduced to a minimum. Chief among these are alcohol, coffee, tea and tobacco. The reptilian habit of concentrating the daily nourishment in one enormous meal, a habit on which some individuals pride themselves as though it were the acme of scientific dietetics, is to be emphatically condemned. Such a gargantuan repast is followed by hours of arterial hypertension, which might be avoided by consuming it in sections, so to speak, and at appropriate intervals. Notwithstanding von Noorden's[2] opinion to the contrary, the writer is in favour of a diet that is largely vegetarian.

"The recent researches of Schlesinger and Neumann,[3] upon the digestive functions of thirty healthy individuals over sixty years of age, have demonstrated that while starch and fat are thoroughly digested, the digestion of meat is, as a rule, difficult and imperfect. This is in

[1] In one-third of 386 autopsies upon arteriosclerotic subjects, Boinet found the adrenals hypertrophied. (Quoted from Gouget, "L'arteriosclerose et son Traitment," Paris, 1907.)

[2] *Med. Klinik*, Jan. 5, 1908. [3] *Wiener klin. Wchnschr*, Mar. 5, 1908.

remarkable analogy with the fact that most individuals as they advance in life restrict their daily consumption of animal food with distinct advantage to their physical condition. The morning meal of the arteriosclerotic should consist of some cereal food with a glass of milk or a cup of *café au lait*, or better still of one of the numerous well-known substitutes for coffee, and a slice or two of bread and butter. This may sound like very short commons for a man addicted to the morning chop or steak, but it is abundant nourishment, *experto crede*, for the healthiest and most robust individual.

"Without entering into further details, for each case has to be separately studied from the dietetic standpoint, suffice it to say that three light meals a day are all-sufficient, and that half a pound of meat and a pint of milk will supply the requisite amount of animal food. Above all things, it is important that the food be triturated by the teeth to the last degree of subdivision and be thoroughly mingled with the saliva. The remarkable results produced by thorough insalivation of food, as advocated by Fletcher, seem to prove that the first stage of digestion, that which takes place in the mouth, is almost, if not quite, as important as that which occurs in the stomach and intestine.

". . . I have derived signal success, in cases of angina, from a remedy of which practically no mention is made by writers upon this disease. I refer to aconite. Under the use of two or three drop doses of the tincture I have seen marked mitigation both of the frequency and severity of the paroxysms. It is not, like morphia, nitrite of amyl, and nitroglycerin, an emergency remedy, but for long-continued use I have found it more valuable than any other drug and can recommend it with entire confidence. It may be given most advantageously in association with sweet spirits of nitre.

"Chloroform should never be employed in cases of angina, either for the relief of pain or for the production of anæsthesia in case of absolutely necessary surgical operation."

Professor Reginald H. Fitz, of Boston, sent me as the

expression of his opinion, "The Clinical Significance of Arteriosclerosis."[1] He says:—

"The difficulty experienced by the pathologist in unifying the various anatomical changes found in arteries of large and small calibre makes it necessary for the practitioner to be especially cautious in generalizing with regard to the clinical manifestations of arterial disease. It is important for him to weigh carefully the evidence in the individual case, that he may attach the proper value to it in determining questions of diagnosis and treatment.

"It would seem, therefore, of clinical convenience to consider arteriosclerosis as a morbid process which may affect the central, peripheral and visceral arteries of the body. Each group alone may be concerned, or two or more groups may share simultaneously in the process. Usually the effects of arteriosclerosis are more apparent in a single group, and in visceral arteriosclerosis the results are more conspicuous in one organ than another, although combined disturbances of several organs are frequent in consequence of various degrees of arteriosclerosis in each. Hence there is no typical picture of arteriosclerosis from a clinical point of view, but there are several diseases variously designated which may be attributable to arteriosclerosis. This term, therefore, to the clinician, represents rather a species than a genus, and strictly speaking should be used as an adjective, not as a substantive."

To quote from "The Practice of Medicine," by Horatio C. Wood and Reginald H. Fitz, published in 1897, chapter iv., "Diseases of the Arteries: Arteriosclerosis":—

". . . The relation between chronic fibrous nephritis and arteriosclerosis admits of a threefold interpretation: first, that both the nephritis and the arteriosclerosis are the results of the same cause; second, that the nephritis causes a toxæmia from the insufficient elimination of the products of tissue metamorphosis, which act as a cause of the arteriosclerosis; and third, that the arteriosclerosis causes the nephritis."

[1] Extract from an address before the Hampden Medical Society at Springfield, October 21, 1902. Published in *Boston Medical and Surgical Journal*, April 2, 1903, vol. cxlviii., No. 14, pp. 357–369.

Dr. Warfield T. Longcope, of New York, has sent a reprint describing his well-known work on syphilitic aortitis.[1] While this is a little apart from our subject, I can confirm from long experience what he says of the effect of treatment in some of these cases.

". . . It has, however, been impossible to escape from the fact that certain of these patients have been benefited by salvarsan treatment, and this after all is not especially surprising, for these individuals must be regarded as suffering not only from a mechanical defect in the circulatory apparatus, but as well from a localized chronic infection. Thus it is reasonable to suppose that if this infective process is ameliorated, or cured, the general condition of the patient will likewise improve. In most instances this has been the case. The majority of patients feel considerably better after one or two injections. The patients who have improved sufficiently go back to work to report that they feel stronger and better than they have for years. Few, however, have gained weight, though the appetite increases."

Dr. R. M. Pearce, of Philadelphia, writes me as follows:—

"My work on arteriosclerosis has been mainly on the experimental side, and I regret that my collection of reprints is exhausted.

"The original papers appeared as follows:—

"1. Pearce, R. M., and Stanton, McD., 'Experimental Arteriosclerosis,' *Journ. Exper. Med.*, Baltimore, 1906, vol. viii. p. 74; also *Trans. Assoc. Am. Physicians*, 1905, vol. xx. p. 513.

"2. 'Experimental Myocarditis,' *Journ. Exper. Med.*, Baltimore, 1906, vol. viii. p. 4000.

"3. With L. K. Baldauf, 'A Note on the Production of Vascular Lesions of the Rabbit by Single Injections of Adrenalin,' *Am. Journ. Med. Sc.*, Phila., 1906, vol. cxxxii. p. 737; also *Trans. Assoc. Am. Physicians*, 1906, vol. xxi. p. 792.

"4. 'On the Occurrence of Spontaneous Arterial Degeneration in the Rabbit,' *Journ. Am. Med. Assoc.*, 1908, vol. li. p. 1056.

"5. 'The Relation of the Lesions of the Adrenal Gland of Nephritis and Arteriosclerosis,' *Journ. Exper. Med.*, Baltimore, 1908, vol. x. p. 755.

"6. 'An Experimental Study of the Influence of the Kidney Extracts and of the Serum of Animals with Renal Lesions on the Blood Pressure,' *Journ. Exper. Med.*, Baltimore, 1909, vol. xi. p. 430.

[1] "Syphilitic Aortitis: Its Diagnosis and Treatment," published in *Archives of Internal Medicine*, January 1913, vol. ii. pp. 15–51.

"I also send under separate cover some reprints which, although they do not deal directly with arteriosclerosis, may be of some interest to you."

Among the reprints which he enclosed was one on "The Retention of Foreign Protein by the Kidney."[1] His summary of his conclusions is as follows:—

"Extracts of the kidneys of normal rabbits prepared one, two, three, and four days after the intravenous injection of one-egg albumin and horse serum have the power to sensitize guinea-pigs to a second injection of these proteins. The sensitization by first- and second-day extracts was constant and intense, that by the third-day extracts was less marked and sometimes was not evident, and that by the fourth-day extracts was only occasional, and when present was always weak.

"Comparative studies of the power of the blood, liver and kidney to sensitize, indicate that this sensitization depends on the content of the foreign protein in the circulating blood and not upon its accumulation or fixation in the tissues of an organ. This opinion is supported by other experiments in which the sensitizing power of the blood and of the extracts of the unwashed kidneys was compared with the sensitizing power of extracts of washed kidneys.

"The weak sensitizing power of washed kidney extract is taken as evidence that foreign proteins of the kind used are not held in the tissues of the kidney, and if these results may be applied to nephro-toxic proteins, it follows that nephritis is not due to selective and persisting fixation of a protein by the renal cells, but is due to the action of such protein merely during the process of its elimination.

"In experimental acute nephritis of the type due to uranium nitrate, the power of sensitization of egg-albumin is prolonged for twenty-four hours, and in the chromate type for forty-eight hours, thus indicating that in nephritis, of the acute type at least, the elimination of a foreign protein is delayed."

The bearing of these experiments on clinical medicine is

[1] Published in *Journ. Exper. Med.*, 1912, vol. xvi., No. 3.

of course only remote, but in research work the things that are least suggestive at the time prove valuable later. And such workers as Dr. Pearce are the ones who will eventually test the correctness of the author's theory as to the causation of arteriosclerosis in regard to sensitiveness to particular proteins.

Dr. Robert D. Rudolf, of Toronto, writes me as follows:—

"Your letter of the 5th inst. to hand. I recently read with great interest the reprints of 'Fibrillation of the Auricle and Arteriosclerosis' which you were good enough to send to me, and am glad now to hear from you personally.

"I am afraid that I have not written very much (except perhaps on the minds of my students!) on the subject of arteriosclerosis, but have always taken a special interest in it. I enclose a reprint of a short article that I had in the *British Medical Journal* of a couple of years ago. Also I can give you the following references to articles of mine, of which I do not happen to have reprints left:—

"'Blood Pressure in Arteriosclerosis,' *Am. Journ. Med. Sc.*, Phila., September 1908.

"'Observations on Blood Pressure,' *University of Toronto Study*, 1901.

"You may also be interested in a recent article on aconite, in which some reference is made to its want of effect on the heart rate and also on the blood pressure, in medicinal doses. I enclose it. You ask my personal views on the philosophy of the development of arteriosclerosis, and of how much the prognosis may be influenced by regimen! It is a big question, and I am very hazy about the matter. I think that the chief element in the development is the inherence of vascular tissue that tends that way. Again and again one sees people die of the disease who have lived perfect lives as regards food and every other factor, and in them there is always a history of family tendency in that direction. Alcohol has very little influence in my experience. I will read your book with great interest."

His résumé of high blood pressure in arteriosclerosis is very complete and interesting.[1]

[1] "High Blood Pressure in Arteriosclerosis," Pub. *British Med. Journ.*, November 26, 1910.

"Probably one may say, without much fear of contradiction, that when in a case of arterial thickening a raised blood pressure is detected, such a rise may be due to one or more of the following causes:—

"1. Toxæmia; such toxæmia being at the same time the direct cause of the arterial disease by directly poisoning the vessel walls. A good example of such a poison is nicotine, which directly raises the blood pressure, and, according to many authorities, also acts directly on the vessel wall as a poison. Probably there are very many such toxins manufactured in the alimentary tract or in the tissues of the body.

"2. Some toxin which has nothing to do with the associated arteriosclerosis, but is directly raising the pressure. One might theorize that in an arteriosclerotic patient the adrenal tissues might be from time to time overactive, and might thus produce periodic rises in pressure, as might occur in individuals not arteriosclerotic.

"3. Compensatory. It is well known that if some vital tissues, such as those in the medulla, be rendered anæmic—say, by the pressure of a new growth—the blood pressure rises enormously, seemingly with the object of forcing blood at all hazards into the part. If such a part of the brain be supplied by a vessel the lumen of which is much narrowed by disease, it is likely that the blood pressure will rise from the same cause.

"4. Simple nervousness. It is very common to find the pressure high from nervousness, and if an arteriosclerotic happens to be also a neurasthenic, his pressure may be high from this cause alone.

"5. Lastly, the raised pressure may be due to the arterial disease alone, and in this case probably the splanchnic vessels, or the aorta leading to them, are extensively diseased.

"While the rôle of arteriosclerosis in producing hyperpiesis is thus open to much limitation, the rôle of hyperpiesis as a producer of arterial disease seems to be an important one. Given a constantly or occasionally increased blood pressure within the arterial tree for any length of time, and the arteries will tend to be dilated, and in order to prevent

this dilatation the arterial walls will tend to hypertrophy and thicken, as will also the wall of the left ventricle."

Dr. W. Gilman Thompson, of New York, writes me as follows:—

"I have not written anything on arteriosclerosis for a dozen years. In simultaneously visiting at the Presbyterian and Bellevue Hospitals I have often noticed a great preponderance of this disease in the latter institution, which is so much more frequented by hard-working labouring men.

"Even when not syphilitic or alcoholic, those who have worked hardest in digging or as longshoremen, packers, etc., show the disease at a comparatively early age. I have been convinced that the heavy manual labour which gives rise to cardiac hypertrophy and constant excessive pressure in the arterial system, together with the toxic products of excessive muscular work, is fully as potent an etiological factor as alcohol, syphilis or the metal poisons.

"I believe that in general the prognosis depends mainly upon how much care the patient is able to take of his mode of life. It is my observation that much benefit may be derived by greatly reducing the intake of fluids, a dietary containing a minimum of proteid food, refraining from heavy lifting or other strenuous muscular labour, restriction of the use of tobacco, elimination of alcoholic beverages, frequent catharsis and such hydrotherapy as tends to promote sweating and reduce arterial pressure. Except in obviously syphilitic cases, I am not convinced that the iodides or other medicine are of any value, and except that for temporary use, when tension is very high, five-grain doses of chloral hydrate are often effective."

The class of heavy labourers to whom Dr. Thompson refers constitute a type of individual in whom many causes may be active, and it is hard to believe that the labour alone is the cause.

Dr. Herbert U. Williams, Dean of the University of Buffalo, raises interesting points in his letter:—

"In reply to yours of 6th February, I have written an article, appearing in the *Archives of Internal Medicine*,

1910, vol. vi. p. 702, on the histological study of the sweat glands in 75 cases of chronic kidney disease, mostly chronic interstitial nephritis. In this article, the fact that arteriosclerosis frequently affects the vessels nourishing the sweat glands appears. As far as I know, that aspect of arteriosclerosis has not been touched upon elsewhere. I am sorry that I cannot send you a reprint, but the supply is exhausted.

"My idea of the philosophy of arteriosclerosis appearing late in life is that it is the result of wear and tear on the elastic tissues of the arteries. I always have students calculate the number of times that the elastic tissue is first stretched and then contracts, taking the number of heart-beats in a minute, multiplying by 60 minutes in an hour by 24 hours by 365 days by 50 or 60 years; the result is quite impressive. No rubber or other elastic material could respond under like circumstances without suffering. Many cases, of course, are toxic in their cause, and often the two factors are combined.

"In the main, Thoma's theory of arteriosclerosis is satisfactory."

Dr. Isaac Adler, of New York, writes as follows:—

"In answer to your letter of the 5th instant, I send you, under separate cover, a reprint of a paper of mine, written nearly five years ago. I am inclined to think that the five years that have passed since that paper was written, have not added materially to our knowledge of arteriosclerosis. We have not been enabled to produce anything like arteriosclerosis experimentally. Rabbits do not count, because atheroma of the arteries occurs so frequently in these animals spontaneously.

"There is no unity as to a definition of what arteriosclerosis really is. So simple a question as to whether it commences in the smaller or larger arteries, or in both, has as yet not been definitely answered.

"Although there is an enormous amount of literature on the subject, no two authors seem to agree on the etiological factors concerned in the production of the disease.

The relation of blood pressure to arterial disease is still a matter of speculation rather than of positive knowledge.

"As to the practical side of the question, how to interpret the clinical phenomena, how to prevent or treat arteriosclerotic conditions, and, finally, what the prognosis may be; all that depends so absolutely upon the condition as found in each individual case, that it is impossible for me, at least, to venture any general statement.

"I am, unfortunately, one of those few persons who are convinced that our knowledge of arteriosclerosis is in inverse proportion to the literature on the subject."

One of the most delightful responses to my letter was from Dr. James J. Putnam, of Boston, and is as follows:—

"I have always been greatly interested in arteriosclerosis, and have assumed that underneath all the special causes which have been reported there lay a tendency which could be classified, though not easily explained, under the heading of 'abiosis.' You probably are aware that Dr. Gowers among his many other valuable papers, wrote an article on the subject of 'abiosis' which was certainly suggestive. The point was that the different structures of the body have a sort of life-history which differs in each case. Of course it may be true that fatigue, *à la* Edinger, precipitates somewhat this tendency to special retrogression and death on the part of one or another tissue. I believe myself, however, that the tendency, even of fatigue, while doubtless important, has been over-estimated.

"Professor C. S. Minot of our school has written several valuable papers on death in relation to growth, etc., which would bear upon this point. Of course, with my interests, and from my present standpoint, I feel positively convinced that the time will come when we shall express a great deal, which now has to be put in anatomical terms, in terms of function. It must be evident to any really thoughtful man that we know nothing about structure except in terms of function; that is, we know nothing about a thing except by recognizing how that thing acts on us—through our sensations, etc.

"I have never tried to express the 'abiosis' doctrine in terms of function, but do not feel at all sure that it would not be profitable to attempt it."

Dr. Richard C. Cabot, of Boston, writes as follows:—

"I enclose a reprint.

"I know practically nothing about the cause of arteriosclerosis, though I believe that alcohol and syphilis acting together have some influence.

"I have never seen any medication or regimen—except *general moderation*—that influences its development."

Dr. Cabot's conclusions found in the reprint[1] enclosed are so famous that I quote them again:—

". . . 1. Only 6 per cent. of 283 cases of chronic and excessive alcoholism under 50 years of age showed any evidence of arteriosclerosis.

"2. Of 45 cases of arteriosclerosis examined by me at the Massachusetts General Hospital, only 13 per cent. gave any history of alcoholism.

"3. Of 656 autopsy cases of arteriosclerosis, only 95, or 14·5 per cent., were under the age of 50.

"4. Out of these 95 cases under 50, in which arteriosclerosis was found post-mortem, only 21 per cent., and if we exclude cases complicated by chronic nephritis, only 17 per cent., appear to have consumed alcohol in any notable excess."

My good friend, Dr. Robert H. Babcock, of Chicago, has kindly written me his opinions as follows:—

"Thank you very much for the flattering request contained in your letter of 5th February. I have not written anything on arteriosclerosis since the appearance of my book, and feel that my views will carry but little weight.

"It seems to me, however, that aside from certain family or hereditary tendencies the development of arteriosclerosis depends largely on chronic infections and on changes initiated during some acute infection in earlier years. This seems to

[1] "The Relation of Alcohol to Arteriosclerosis." Read at Fifty-fifth Ann. Session of American Medical Association, Sec. Practice of Medicine. Pub. in *Journ. A.M.A.*, 17th August 1904.

be particularly the case in general arteriosclerosis, whereas the stiffening of the vessels and hypertrophy of the heart that go with high blood pressure depends on changes first initiated in the arteries controlled by the splanchnic system. These changes, in my experience, are met with most frequently in persons of rather sedentary habits who suffer from intestinal intoxication, whether conscious thereof or not.

"I believe also that chronic focal infections, especially of the gall bladder and appendix, are etiological factors. To my mind the whole subject is rather conjectural than capable of positive proof at present.

"As regards prognosis; sclerosis of the general vascular system, especially of the extremities, is compatible with long life. It is sclerosis of the aorta and its branches, with high blood pressure, that furnishes grave prognosis. The whole matter of prognosis is so difficult that I hesitate to make a general statement.

"Treatment in my hands has seemed to excite no effect on the disease itself, and I believe must be directed to obviating the circulatory and visceral disturbances incident to the arteriosclerosis. I realize, however, how inadequate the above statements are and how in a sense they seem to beg the question, but at present in the limits of a letter I can say nothing more."

Dr. Leo Loeb, of St. Louis, has written me the following valuable opinion of the toxic origin of arteriosclerosis:—

"I am very glad to send you the reprints for which you ask. I have no personal experience concerning the prognosis and treatment of cases of arteriosclerosis in human patients. I am, however, inclined to believe, on the results of experimental evidence on hand at the present time, that toxic influences are the main factor in the development of arteriosclerosis, and also that there is only a quantitative difference in the diseases of the aorta in rabbits produced through the injection of adrenalin or nicotine and the affection of the larger and smaller blood vessels which affects primarily the intima."

Dr. George W. Norris, of Philadelphia, has written as follows and enclosed a separate sheet:—

"I do not know that I have ever written much on the subject of arteriosclerosis. It is, as you realize, a subject upon which much might be written. I have endeavoured to condense in the accompanying enclosure what I might perhaps best describe as my *credo* on the subject:—

"Arteriosclerosis is the natural process of ageing—the result of life's wear and tear. It manifests itself first by a degeneration and later by a calcification of the arterial wall. The latter is essentially conservative and compensatory in Nature—an effort to strengthen weak spots. Calcification occurs to a variable degree in different cases, and is no index of the severity of the actual arterial lesion. Arterial degeneration, while greatly influenced by hereditary tendencies, may be hastened or delayed by the mode of life. Thus a proper regulation of the daily routine—of work or relaxation, of exercise and rest, of food and of fasting—may do much to not only prolong life but to make it more enjoyable. The auto-intoxication hypothesis has never greatly appealed to me.

"Undoubtedly, infections of various kinds, especially syphilis, play an important rôle; while modern stress and strain—doing things under pressure and against time, too often with the aid of 'stimulants'—is not to be underrated.

"The precept of Terence may be taken as a good rule of life, especially for individuals with arteriosclerotic tendencies: 'I take it to be a principal rule of life not to be too much addicted to any one thing.'"

My friend, Dr. T. B. Futcher, of Baltimore, has written as follows:—

"I regret to say that I have never written anything for publication on the subject of arteriosclerosis. Of course I am very much interested in the disease, as it plays such an important part in hospital and private cases.

"As to my views concerning the etiology, they naturally accord with those usually taught in the best text-books of medicine. Here in Maryland, in addition to the other usual etiological factors, we dwell a good deal upon the influence of overeating as an etiological factor.

"From the standpoint of therapy, I have never seen anything that has shown any tendency to reduce the sclerosis, and in most cases it will progress in spite of anything we do. I think it is within the realms of possibility that by restricting a man's physical and mental responsibilities, reducing the intake of food, and cutting out contributory poisons, such as alcohol, lead, etc., something may possibly be done in retarding the progress.

"I am sorry I cannot contribute anything new to the subject, but shall look forward with pleasure to the appearance of your monograph."

Dr. C. P. Howard, of Iowa City, Iowa, writes as follows:—

"I may say my views are the usually accepted and orthodox views as outlined in the article in Allbutt's 'System of Medicine,' or in Osler's 'Modern Medicine.' Klotz of Pittsburgh has contributed a lot of valuable experimental and pathological work in recent years. A letter addressed to him at the University of Pittsburgh would no doubt reach him."

Dr. B. Sachs, of New York, writes:—

"It is a subject that plays into many others. I have a distinct impression that when it occurs in very youthful individuals it is largely due to a specific infection or to the excessive use of tobacco. When it occurs after the age of fifty-five or thereabouts I regard it as almost a physiological necessity, or, in other words, the natural accompaniment of other senile changes. In diagnosis arteriosclerosis has been worked to death by many, and I think it will be very wise carefully to outline the clinical pictures that may be considered to be dependent upon arteriosclerosis and nothing else."

Dr. Lewellys F. Barker, of Johns Hopkins University, writes:—

"In reply to your letter of 5th February, I may say that I have not written directly upon atherosclerosis, though in the two reprints I am sending you, one on the cardiopathies and the other on the nephropathies, you will find atherosclerotic disease of the heart and atherosclerotic diseases of the kidneys referred to, with some points on regimen."

Points of most interest to our subject in his reprints are those concerning the treatment of renal disease : [1]—

"In the *treatment* of renal diseases, the dictum of Traube still holds good : 'Protect the kidneys and control the heart.' In addition to the principle of protection, we can also, at certain stages, successfully apply the principle of exertion to the renal function.

"In the protective therapy, we avoid, as far as possible, all further injury to the kidney by intoxication (lead, gout, alcohol, etc.) or infections (chronic tonsillitis, anginas, etc.), and we can lessen, also, the amount of work thrown on the kidney, in normal metabolism, (1) by choosing a suitable diet (limitation of proteins to 100 to 125 grams meat, or its equivalent, of water to 2 litres, of sodium chloride to 8 to 10 grams and irritating condiments; (2) to a slight extent, by increasing the eliminatory functions of other organs (skin, intestines, lungs); and (3) by lessening the amount of physical or mental work done each day, and advising periods of rest, lying down, in the middle of the day. In cases in which the renal disease is compensated, such protective measures are all that is necessary.

"To get patients well started on a suitable dietetic régime, the foods should at first be carefully weighed or measured. For this purpose, Dr. C. W. M'Elfresh, of Baltimore, has found it very helpful to enlist the aid of nurses especially trained in dietetics.

"In every case of renal disease, the condition of the heart should be carefully watched. Indeed, chronic passive congestion of the kidneys, due to cardiac insufficiency, may, of itself, cause marked albuminuria and cylindruria. The albumin, as well as the casts, may disappear from the urine when cardiac compensation is re-established. And when the kidneys, themselves, are diseased, the urinary symptoms may be markedly exaggerated if the heart begin to fail. 'Every renal patient

[1] "The Commoner Forms of Renal Disease, with Special Reference to the Knowledge of the Most Useful at Present to the General Practitioner," *Am. Journ. Med. Sciences*, January 1913, No. 1, vol. cxlv. p. 42.

is also a cardiac patient'; in treatment, this should always be kept in mind.

"The treatment of cardiac insufficiency I shall not go into at this time, as I have already dealt with that topic in a former paper.[1] When the renal disease is not compensated, the kidneys having become insufficient, the rest of the body begins to show certain ill effects, of which the two most important are (1) œdema and (2) uræmia. In such cases we must make our protective régime still more rigorous, often keeping the patient in bed at complete rest for a time; in addition, we may find it necessary to stimulate renal excretion by diuretics which improve the blood flow through the kidney and excite the renal epithelial cells to increased work.

"In combating œdema in renal disease, we use diuretics, a salt-poor diet, mild purgatives, and, when necessary, heart tonics. Diuretin, and the still more powerful theocin, are both excellent stimulants to the renal epithelium, while digitalis preparations improve the circulation in the kidney. In giving diuretin, a dosage of 0·5 gram at 2 p.m. and the same amount at 5 p.m. every other day for a few days may suffice; if not, as much as 4 grams may be given in one day. In giving theocin, 0·1 to 0·2 gram at 10 a.m. and at 4 p.m. every other day for a few days may suffice; if not, as much as 0·8 to 1·0 gram may be given in twenty-four hours. The renal cells may cease to respond; if so, the medication should be stopped, to be tried again a few days later.

"The influence of a salt-free (or salt-poor) diet in reducing renal œdema is sometimes remarkable, especially in acute cases; but a salt-free diet should never be kept up for a long time, or it will do more harm than good. The intake of NaCl may be reduced to 2 or 3 grams per day; in many instances, a reduction to 5 grams per day may suffice. The patient is told to add no salt to his food, and he may use salt-free bread and unsalted butter, together with one litre or one and a half litres of milk.[2] Sugar, rice, potatoes, stewed

[1] "On the Treatment of some of the Forms of Cardiac Failure," *Virginia Medical Semi-Monthly*, 1911, vol. xv. pp. 457–486.

[2] Milk is not salt-free; it contains 1·6 grams of sodium chloride per litre.

fruit, fresh green vegetables, salad, chocolate, coffee, tea and cereals, if no salt be used in their preparation, are practically salt-free foods. Meat and eggs are also salt-free, but should not be used to any great extent, on account of their high protein content. In the French clinic of Widal, a salt-poor diet, consisting of 200 grams of salt-free bread, 200 grams of meat, 250 grams vegetable, 50 grams unsalted butter, and 40 grams sugar is employed. Such a diet contains 1500 calories, and is sufficient for a patient lying in bed. It represents about 60 grams of protein—a low value. I have seen patients on a similar diet lose 20 to 30 pounds in a week, from reduction of the œdema. The strict salt-free (or salt-poor) diet should not be continued for longer than a week at a time, preferably not over three or four days; then a little more salt (1 to 3 grams) may be permitted, but as far as possible the individual tolerance should be determined, and the patient kept within it. When the patients have a high tolerance for NaCl, there is no good in restricting the salt intake to very small amounts.

"In the treatment of uræmic symptoms, similar principles are followed, namely, vicarious elimination by mild purgation and diuresis, cardiac tonics, protective diet. When uræmia is threatened, it may be well to limit the food, for a short time, to milk sugar dissolved in water, and fruit juices; later, milk may be added. In some cases of uræmia, venesection may be life-saving; when convulsions recur frequently, lumbar puncture may be tried. In uræmic asthma, a small dose of morphine may be necessary. If there be insomnia, or marked nervousness, we may give 0·1 gram of veronal at 2 p.m., at 5 p.m., and 8 p.m. for a time.

"In the management of contracted kidney, we attempt to prevent further action of the cause (atherosclerosis; streptococcus intoxications). To combat a developing atherosclerosis, the whole mode of life has to be systematically ordered. A lacto-vegetarian régime is instituted, and several small meals per day substituted for three large ones. Constipation, if present, is overcome, as is also abnormal intestinal fermentation (administration of *Bacillus bulgaricus*).

The blood pressure should be watched, but it must be borne in mind that the hypertension is a compensatory process, rarely to be combated directly by the high-frequency current or by vasodilating drugs (nitroglycerin; sodium nitrite; vasotonin), but, as far as possible, by a prevention of the intoxication which causes it—that is to say, by dietetic and general hygienic measures. Above all, the strength of the heart must be maintained, for, unless he die of apoplexy, the patient suffering from contracted kidney, sooner or later, suffers from cardiac insufficiency. When this begins to appear (dyspnœa, cardiac œdema), or if uræmia be threatened, complete rest and digitalis therapy are indicated; diuresis may be favoured by diuretin or theocin, the bowels kept open by mild laxatives, and the skin active by warm packs. Violent sweating is to be avoided.

"In contracted kidney, the patients usually pass large quantities of urine. Sudden reduction of the amount is usually a bad sign; it may indicate either a failing heart, or an acute nephropathy, superimposed upon the contracted kidney.

"If his life be well regulated, a patient suffering from contraction of the kidneys may go along for many years, even for decades, in comparative comfort, especially if he chooses a good climate to live in and avoids infections and chilling of the skin."

Also, we have only space to quote a few notes by Dr. Barker on the question of carbonic acid baths:[1]—

"Much has been written about the use of *carbonic acid baths* as strengtheners of the heart, and there has of late been much criticism also of these baths. In my mind there is no doubt that the carbonic acid bath is really a very efficient agent in cardiac therapy, provided the baths are used only when indicated and then only by those thoroughly trained in their application and conversant with their effects, for they

[1] "On the Treatment of Some Forms of Cardiac Failure." An Address delivered before the Medical Society of Virginia at its Forty-first Annual Session, at Norfolk, October 25–28. Reprinted from the *Virginia Medical Semi-Monthly*, 1911, vol. xv. pp. 457–486.

can be a grave menace to the welfare of the patient rather than a benefit when employed by the tyro. While there can be but little doubt, as James Mackenzie points out, that a large part of the benefit derived from Nauheim and other bath-resort treatment is due to the rest, change, diet, etc., of these places, nevertheless, the carbonic acid baths in themselves are exceedingly useful therapeutic measures in selected cases, and especially because the stimulus applied can be very exactly graded and thus suited to the individuality of the case in hand. The blood pressure rises in the bath and continues higher for from fifteen minutes to half an hour, and the pulse is slowed. One can vary the strength of the stimulus by varying the amount of gas and the temperature of the water. The cooler the bath and the richer in carbon-dioxide the stronger the stimulus. At Nauheim the patient is always given an indifferent bath first and then experiments are most cautiously made to see how the patient responds. The excellent results obtained there in many cases are doubtless due to the large experience of the men who have devoted years to the work. Of course these baths are applicable in only very moderate grades of cardiac insufficiency. They are wholly contra-indicated in the severer grades.

"The third method of strengthening the heart muscle is that which involves the use of massage and later of *systematic active and passive movements.* Too little attention is paid in this country to the application of modern mechano-therapy in the treatment of cardiac cases, though the methods have been most carefully worked out by our European confrères. One reason of the relative neglect here lies in the absence of good mechano-therapeutic institutes with trained attendants. Another is the disgust which has been aroused in many of us by the unhappy misapplication of mechano-therapeutic methods by the unskilled and ignorant."

Dr. Henry Sewall, of Denver, writes as follows:—

"I have not done any research work on arteriosclerosis. I have long thought the large pulse pressure common to the condition to be a physiological compensation against the loss of elastic energy-storage capacity of the vessels. I can

hardly think that facts at present known are sufficient to base a final theory of the condition on.

"I am inclined to believe the development of arteriosclerosis to indicate a nutritive senility dependent possibly on failure of certain internal secretions. The recent work of von Aurep (*Journal of Physiology*, 1912, xlv. 307 and 318) demonstrates clearly the extraordinary effects upon local vascular activity of chemical substances in the circulation. During a recent visit to Ancon, Dr. Darling showed me a small, white, cirrhotic kidney which was *not* accompanied by arteriosclerosis. He said the condition was common in the Canal Zone, and was attributed to concentration of metabolites due to abundant sweating."

Dr. W. T. Councilman, of Boston, writes as follows:—

"I am very sorry that I have not anything on the subject of arteriosclerosis. I have not written on it for some time and not thought a great deal about it, but I fully adhere to the late views with regard to the syphilitic lesions, and I pretty fully still accept the views of Thoma on the subject."

Dr. John K. Mitchell, of Philadelphia, believes as I do:—

"As a matter of personal opinion I am very definitely of the belief that the progress may be to a great extent controlled by regimen, even in cases already advanced, diet and the absence of mental excitement or over-stimulation being the most important factors."

Dr. Joseph Sailer, of Philadelphia, writes:—

"I wrote an article with Dr. Pfahler on 'Tortuosity of the Aorta,' *American Journal of Medical Sciences*, October 1903."

This article of Dr. Sailer's refers to a very important matter, the frequency of fluoroscopic suggestions of an aneurysm which does not exist. My own observations are, that finally all persons with very high blood pressure in arteriosclerosis have a projection to the left; and Dr. Sailer's failure to discover the equivalent dilatation after death was, of course, due to the absence of blood pressure.

Dr. Henry Jackson, of Boston, writes:—

"It gives me great pleasure to send you a short, purely clinical, article on arteriosclerosis."

In this paper[1] Dr. Jackson says:—

"It is to me a deplorable fact that the laity are so conversant with and talk so much about hardening of the arteries, without, of course, any idea of the significance of the changes in the specific case under consideration. We are all of us often asked whether we think the arteries are hardened, and in many cases we can truly say yes, the arteries have changed just as the appearance of the skin has changed, but the arterial change means no more than the hardening of the skin means, a mark of advancing age. I often say to a patient that if a hand were pushed through a sheet he could at once say whether it was the hand of a man of twenty-one or fifty-one years; so the physician can discriminate between the arteries of a man of twenty-one or fifty-one years; though a decision as to the results of such arterial changes is a very complex matter, leading often into regions unexplored and obscure.

. . . . . .

"Among the most important symptoms of localized arteriosclerosis are the disturbances of the nervous system, central and peripheral.

"*Central.*—Vertigo is a common and often very annoying symptom in elderly people, due to an interference with the circulation of the brain; also tinnitus, for which we find no local cause of any disturbance of the ear. Often these are the only symptoms that a patient with marked sclerosis complains of.

"Epileptiform seizures in old people represent a more extensive involvement. It is important to recognize such a cause for these attacks that we may not make a diagnosis of epilepsy and institute treatment for that disease. The anatomical distribution of the cerebral sclerosis may be in such a situation and lead to so marked degeneration of the cerebral tissue that a progressive dementia gradually comes on.

[1] "The Clinical Aspects of Arteriosclerosis." Read at the Annual Meeting of the Massachusetts Medical Society, 7th June 1910.

"Transient monoplegia and transient attacks of aphasia are frequently seen; the question arises whether the symptoms are due to small hæmorrhages or emboli. In many cases the diagnosis is obscure, but the rapidity with which many cases recover seems to preclude the probability of such definite pathologic lesions. Further, frequent post-mortem examinations in cases under my care, in whom during life I had observed several attacks of paralysis of short duration, have failed to show any evidences of a preceding hæmorrhage. But the cerebral vessels were markedly sclerotic. The probability is that such symptoms are due to a spasm of the vessel walls, which temporarily impedes the circulation. The clinical name of vasomotor ataxia is not unsuitable if we bear in mind that it is only a name, and does not prove the exact pathologic condition.

"*Peripheral.*—A very interesting class of cases similar in type to the cerebral cases just spoken of represents many forms of 'rheumatism,' especially muscular rheumatism. An old person with hardened arteries finds that after very moderate walking he has rheumatism in the legs; after a rest or a little rubbing of the part affected, the pain passes. In the interval, when the parts are quiet, there is no pain and no local tenderness. Examination shows that the pain is situated in the muscles and not in the joints.

"Such cases are extremely common, and according to the grade of the arterial lesion may be developed with or without exercise. The most extreme grade of the disturbance is found in the combination of symptoms so characteristic that they are honoured with the name of intermittent claudication; in some cases the loss of function is so marked that there is in addition to the cramp-like pain in the legs actual paralysis. Where the blood supply of the nerves is especially affected, we find symptoms of neuritis rather than muscular pain, as in the class of cases just described.

"In spasm of the abdominal vessels we may find many cases of obscure disease of the abdomen. Such cases are apparently closely associated with the large class of visceral disease combined with local skin disease of the erythema type.

". . . A very large number of cases of 'heart disease' are primarily cases of arteriosclerosis with secondary disease of the heart.

"Such cases are often first called to our attention by a sense of constriction in the chest, shortness of breath on moderate exertion, and attacks of an asthmatic character. The asthmatic attacks may follow any acute bronchial attack, or be the result simply of over-exertion. The blood pressure is always high,—160 or more,—the skin pale, and the pulse rapid, with an occasional intermission."

Dr. H. C. Gordinier, of Troy, writes as follows:—

"I have always felt that arteriosclerosis was in all but a few examples due to a preceding hypertension, the result of faulty metabolism and resulting in an auto-intoxication from toxins elaborated by the intestinal apparatus. I am mindful, however, of the rôle alcohol, tobacco, lead and lues take in its production. Nevertheless, in my opinion it will be found that the great percentage of cases have as antecedents a toxæmia from the bowel."

Dr. Alexander M'Phedran, of Toronto, Canada, writes:—

"I am firmly of the opinion that its occurrence is largely due to inherited viability of tissue. There are many people who never show any abnormal sclerosis, notwithstanding most trying conditions throughout life; just as there are many who show no signs of depreciation of vitality, although they have taken alcohol or smoked inordinately.

"This does not mean, of course, that the mode of life is of no consequence; on the contrary, people who have more vulnerable tissue are pretty certain to go down before the strain of even quiet life before old age is reached, and are likely to do so early if their mode of life has been one of indulgence or dissipation. I have a gentleman in my mind at present who for several years drank very large quantities of alcohol, often one or two bottles in the day; but he lived an outdoor, strenuous physical life. He has also indulged very freely as a smoker, not rarely using twenty cigars a day. Nothwithstanding all these indulgences, his arteries are quite soft and his blood pressure normal. He has reached the

threescore period. He comes of a very good old stock, but, notwithstanding that, as I have told him, he is entitled to a well-advanced arteriosclerosis. He has almost ceased the indulgence in both."

Dr. Warren C. Batroff, of Philadelphia, writes:—

"I believe it is the absolute careful attention to every detail of the treatment which makes for success. We have cases under observation with hypertension to the extent of 296 mm. three years ago still alive and enjoying reasonable health with pressure on average of 226 mm. We always employ venesection in these high cases, always with beneficial results. I believe the air of pessimism with which these cases are usually approached is responsible for the unsatisfactory results of treatment."

Dr. Batroff, in conjunction with Dr. L. Webster Fox, Professor of Ophthalmology, Medico-Chirurgical College of Philadelphia, has written on "The Relation between Retinal Hemorrhages and High Arterial Pressure."[1] In this reprint, sent to me by Dr. Fox, is a tabulation of 100 consecutive cases, and the following interesting points:—

"In following the reasoning usually given, that there is a degeneration of the vessel wall from an accompanying anæmia, or as a result of toxic influences, as chemical poisons, or venoms, introduced into the system, or autogenous metabolic products, the result of a faulty bodily chemistry, we have been led to believe that these are merely predisposing factors, whereas the true or exciting cause of these hemorrhages in a very large proportion of the cases is a sudden, transient, or a persistent, abnormal elevation of the arterial blood pressure.

"Structures containing end arteries, as the eye, brain, or kidney, with their usual delicate capillary endings, are least capable of withstanding this type of a lateral strain imposed upon their walls.

"An examination of the literature on the subject shows that attention has been briefly called to this phenomenon as

[1] Published *Colorado Medicine*, May 1909. Read at Thirty-eighth Annual Meeting of Colorado State Medical Society, Denver, Colorado, September 8, 9, 10, 1908.

a cause of retinal hæmorrhage twenty-five years ago, by MacKenzie and Watson, who studied these cases imperfectly with the sphygmograph; also, more recently, by Dr. E. W. Stevens and Dr. Melvill Black, of Denver (*Journ. A.M.A.*, July 18, 1908).

"That this is an etiological factor, we believe to be partially established by our researches in this particular field during the past two or three years. The studies of the blood pressure, blood and urine of one hundred cases, was decided upon to be investigated with this end in view. The patients examined were those seen within the first forty-eight hours following the hæmorrhage,—the larger number, however, were observed within twelve hours of the onset. In all cases the blood pressure was estimated with the Stanton modification of the Riva-Rocci sphygmomanometer with a 9 cms. cuff. The estimations were made either in the sitting posture with the arm elevated to the level of the heart, or in the supine position with it bearing the same relation to that organ. The systolic pressure only is recorded, as it represents the greatest pressure the vessels were called upon to withstand. A complete blood count and an analysis of the urine, with particular reference to the presence of albumin, glucose or casts, was made in each case. The necessary data in the history and physical examination were then considered in order to determine the predominate factors essential in making a general diagnosis, irrespective of the ocular condition.

. . . . . .

"*Treatment.*—This subject will be considered only with reference to the departures from the usual line of therapy pursued in such cases. In those cases wherein the pressure was found to be abnormally high, in addition to rest, exclusion of light, and the usual local measures, we found that absorption of the clot occurred far more rapidly (from one to three weeks sooner) by employing the following method:—

"All plethoric cases with greatly increased arterial tension were admitted to the hospital and immediately bled from the median basilic vein, following the technic usually employed in venesection for any other condition.

"The sphygmomanometer was adjusted to the opposite arm and the pressure recorded every minute. It was found that it was rarely necessary to reduce it lower than 110 to 120 mm. for those with original pressure from 150 to 200 mm. Cases presenting systolic pressure of 200 mm. or over were seldom reduced lower than 150 mm. We were often compelled to desist before these reductions occurred, owing to faintness of the patient.

"In the less robust, somewhat anæmic cases we practised relieving hypertension with the aid of hot-air baths, electric-light baths or even hot packs with caution. This was found to be nearly as effectual as bleeding in hastening absorption and the restoration of function of the affected eye. In the obese, and when for any reason bleeding was refused or impractical, thyroid extract, grs. ij., t.i.d., was of considerable use as a vasodilator and to diminish the viscosity of the blood. The above methods, while partially satisfactory, did not tend to produce the freedom from recurrence which characterized the cases upon which venesection was performed. A number of chronic nephritics, with whom retinal hæmorrhages had been habitual for months, have been entirely free from attacks during the past two years following treatment. Although within the twenty-four hours following the bleeding the blood pressure recorded was higher than the elevation taken previous to venesection, there would be a daily decline of approximately 10 mm. per day for three or four days, which latter pressure would usually be maintained for several weeks, at least as long as our observation continued. The routine treatment, after patient left the hospital, would be carefully regulated, nitrogenous intake, alkaline waters freely, and warm baths, 110°, for ten minutes, thrice weekly. Medicinal arterial relaxants were used, as sodium iodide, grs. v., in conjunction with sodium nitrite, gr. j., three times a day for three weeks of each month, omitting every fourth month. In those cases with markedly hæmorrhagic tendencies, as where there were both subconjunctival and retinal extravasations, gallic acid, grs. x., three or four times daily, was added to other measures. Hydrargyri cum creta, gr. j., t.i.d., was

used in the autotoxic cases, and where the liver and intestinal tract seemed to be principally at fault.

"The cases of primary and symptomatic anæmia, diabetes and syphilis were, of course, not treated by venesection.

"*Conclusions.*—1st, a large proportion, 80 per cent., of retinal hæmorrhages occur in individuals suffering from a temporary or permanent high arterial blood pressure.

"2. This excessive intravascular pressure is apparently the most frequent exciting cause of these hæmorrhages.

"3. Venesection has proven of value, not only in reducing dangerously high pressure, but in acting as a powerful stimulus to a speedy absorption of the clot."

In another reprint sent me by Dr. Fox, on "Modern Advances in Operations for Cataract and Glaucoma,"[1] he says:—

"*Pathology of Glaucoma.*—Generally speaking, most of our actively acute cases were those in which the eye had previously shown retinal or other intraocular hæmorrhage, rarely hæmorrhage glaucoma. It is considered by many that hæmorrhage glaucoma is caused by these intraocular hæmorrhages, although pathological studies do not always prove this to be true. In typical cases, there are no hæmorrhages into the vitreous, they being confined to the retina. The retinal hæmorrhage and glaucoma are both due to the same cause, which in most cases has been shown to be an obstruction of the central vein due to endophlebitis.

"There would appear to be a relationship between arterial hypertension and arteriosclerosis of the eye, with particular reference to glaucoma. The majority of recorded cases of acute glaucoma occur between the ages of fifty and seventy years; and, primarily, the exciting cause has seemed to have been a disturbance of the balance between the general blood pressure and that of the eye.

"In attempting to explain the relationship existing between high arterial blood pressure *per se* and arteriosclerosis,

[1] Special Address read before Tenn. State Med. Assoc. at Seventy-ninth Annual Meeting at Chattanooga, Tenn., April 10, 1912. Published in *Journ. Tenn. Med. Assoc. of State*, July 1912.

it has been well proven by Elliott and others that there is no absolute correspondence between the extent of the atheroma and the clinical findings. It is moreover true, as the autopsy reveals, that the ordinary clinical type of arteriosclerosis is unaccompanied by high blood pressure in a large percentage of cases; and furthermore, when hypertension does occur, it points to an excessive sclerosis of the renal or splanchnic vessels.

"The necessity for differentiating between arteriosclerosis and arterial hypertension is most important from the standpoint of prognosis and the results to be expected from therapy. In glaucoma the arteriosclerosis is usually a sequel of long-continued hypertension, with the usual pathologic alterations of multitudinous vessel walls as a result. High arterial tension, considered as an entity, is a condition dependent upon perversion of normal metabolic activities resulting in spasm of the vessel walls; which, however, may be prevented from developing into actual arterial degeneration by the regulation of habits, diet and appropriate medication.

"It is therefore paramount for the practitioner to recognize chronic arterial hypertension early, and properly appreciate its importance with reference to ocular manifestations, hæmorrhage and glaucoma. The mere administration of vasodilator drugs to relieve the more pressing symptoms does not afford permanent benefit in retarding the sclerosing processes at work in the vessel walls. A thoroughly detailed eradication of tonic processes and physical and mental overwork must be insisted upon.

"In our recently studied series, eleven, or 22 per cent., were clinically arteriosclerosis, yet the patient's blood pressure was within normal limits for the individual's sex and age. Like results have been the experience of Potain, Groedel, Dreschfeld and others. Apparently hardening of the superficial arteries, upon which the clinical diagnosis of arteriosclerosis is made, does not constitute sufficient cause for the development of arterial hypertension. The sphygmomanometer is absolutely essential in the study of these cases,

as it is impossible for the finger, however skilled, to determine to what extent the hardness of an artery is due to high pressure of the blood within the vessel, or how much is due to thickening of its wall. It is evident that a deeper underlying cause must be sought as an explanation for the variability of the blood pressure in arteriosclerosis, and it is from the kidneys and vessels of the splanchnic area that the answer must come. The frequency with which excessive renal involvement is seen in some cases of arteriosclerosis, constituting cardiovascular-renal disease of certain writers, offers the most satisfactory explanation; as is well known, no other condition is so constantly and uniformly characterized by hypertension as chronic interstitial nephritis. Of the nine acute cases studied, all revealed an arterial tension of 200 mm. or over, the highest being 296 mm. They uniformly revealed the lesions of chronic interstitial nephritis and advanced arteriosclerosis, only one showing mitral insufficiency with pronounced cardiac hypertrophy. All showed rapid and decided improvement, both in the ocular tension and general condition following either venesection or free diaphoresis by the electric-light cabinet."

In an address enclosed, Dr. Fox says:—

"The time is not far distant when the ophthalmoscope will work side by side with the stethoscope and the microscope in the hands of the general practitioner, and when out of the one-time regarded impenetrable mists of ophthalmology will emerge that indispensable knowledge of the correlation of the eye and other parts of the body, and when the physician will possess the dexterity and skill, in the diagnosis and treatment of the more common ocular diseases, that he evidences to-day in diseases of the other parts of the body. This is a heritage which the ophthalmic surgeons of the past fifty years will have handed down to the physicians of the future."

Dr. Eugene M. Blake, of New Haven, Conn., writes:—

"Regarding the production of the sclerosis, I feel that worry and nervous strain are greater factors than we perhaps generally appreciate. At least, I have seen ocular hæmorrhages

so often in women in whom the usual factors of alcohol, tobacco, syphilis, etc., could be excluded, and in whom worry seemed to be the chief factor."

In the reprint enclosed on "Retinal Hæmorrhages and Arterial Hypertension,"[1] he says:—

"If a patient in middle life comes complaining of a blur of sudden onset, he should not be told that it is a trifling matter which will pass off, but a careful fundus examination should be made, best with a dilated pupil. If we find a little extravasation of blood, or any evidence of vascular changes, which often can be detected in no other way in the early stage, the case should be thoroughly studied by the internist. The examination of the urine, blood and especially blood pressure, which is so easily determined, may point to the necessity for medication and changes in the life habits which may spare the patient serious accidents and give many years of life. We shall thereby more perfectly fulfil our obligations in the prevention as well as the cure of disease."

Dr. F. Forchheimer, of Cincinnati, writes:—

"It may interest you to know that in my teaching I refer to the origin of arteriosclerosis as being due to two causes: The first and rarest, structural changes in the artery due to heredity, or being congenital. Secondly, arteriosclerosis is due to increased wear and tear of the artery in the great majority of cases. When both of these classes are combined, then we have the worst forms."

Dr. M. H. Fussell, of Philadelphia, writes:—

"I received your very polite note the other day, asking for any article that I had upon arteriosclerosis. I have nothing, except that in the way of ordinary lectures at the University of Pennsylvania, which I think will be of no particular value to you. My feeling, however, is this: Arteriosclerosis as a very general rule is the result of some infection or toxic condition acting upon the blood vessels' walls. It is not usually accompanied by very high blood pressure, although it may be. I believe the various conditions of interstitial nephritis, arteriosclerosis of the brain

[1] Published in *Yale Med. Journ.*, April 1909.

arteries, of the splanchnics, of the heart, etc., are only local manifestations either of the general arteriosclerosis or of sclerosis of these particular organs.

"As everyone knows, of course, sclerosis of the kidneys, chronic interstitial nephritis, is almost universally accompanied by high blood pressure. This is probably reflex.

"Sometimes sclerosis of the coronary arteries is accompanied by high blood pressure. A high blood pressure can occur when the condition is the result of overwork, overeating, etc., it is true, although when such cases occur (this being based upon clinical references rather than upon post-mortem experience), and they come to autopsy, the kidneys are generally seriously involved.

"In a word, I think that arteriosclerosis may be general with local manifestations, which may or may not be accompanied by high blood pressure, depending entirely upon the disturbance of the organ affected, with blood pressure as a single symptom, and should be so treated, first finding the cause."

Dr. John J. Gilbride, of Philadelphia, sends me an article on "Gastro-intestinal Disturbances due to Arteriosclerosis,"[1] in which he says:—

"Gastro-intestinal disturbances due to arteriosclerosis are sometimes found in patients who have a generalized arteriosclerosis, or in those in whom the splanchnic arteries only appear to be diseased. The cases that come within the latter group are perhaps the more important from the diagnostic standpoint, as the true cause of the symptoms may be overlooked.

Dr. J. G. Gittings, of Philadelphia, sends me a reprint on "Auscultatory Blood-Pressure Determinations."[2] He says:—

"In October 1905, Korotkow, of St. Petersburg, first advocated the determination of blood pressure by auscultation.

[1] Published *Journ. A.M.A.*, March 20, 1909, vol. lii. pp. 955–957. Read before Philadelphia County Medical Society, December 23, 1908.

[2] Published *Archives of Internal Medicine*, August 1910, vol. vi. pp. 196–204.

His method has been thoroughly studied, especially in Germany, and has been adopted by many observers as a routine procedure.

". . . In arteriosclerosis, with hardening and loss of elasticity of the vessel walls, the auscultatory phenomena, according to Krylow, are apt to be more pronounced, since the back pressure at the cuff probably causes some dilatation of the vessel above it, while the lumen of the vessel is smaller than normal. Both of these factors cause an increased rapidity in the transmission of the blood wave when pressure in the cuff is released, which in turn favours the vibration of the vessel walls.

"In high-grade thickening of the arterial walls, however, especially where calcification has occurred, Fischer found that the sounds were distinctly less loud than normal, the more so in the arm which showed the greater degree of hardening. According to Ettinger's experience, the rapidity of the flow distinctly increases the auscultatory phenomena. This accords with the belief that these sounds are dependent upon vibration in the vessel walls.

"Since Janowsky has demonstrated an increased pulse celerity in 60 per cent. of all cases of arteriosclerosis, Ettinger considers that we should be on guard against a possible hypertonia when we find in young individuals that the auscultatory sounds are very clear. This, however, needs confirmation."

Dr. Miner C. Hill, of New York, sends a reprint on "Various Forms of Experimental Disease in the Rabbit,"[1] in which he says:—

"The occurrence of spontaneous arterial disease in the rabbit is an important factor in the experimental study of vascular disease, and a factor the status of which must be definitely determined before the results of experimentation along this line can be definitely accepted. In the course of this investigation 210 presumably normal animals were examined and spontaneous lesions found in 15 per. cent."

Dr. John McCrae, of Montreal, Canada, sends me a

[1] *Arch. of Inter. Med.*, January 1910, vol. v. pp. 22-29.

reprint on a "Case of Multiple Mycotic Aneurysms of the First Part of the Aorta,"[1] and "An Aortic Aneurysm of the Lung,"[2]—a striking symptom in this case was pain and numbness in the arms which, being bilateral, therefore could not be due to pressure."

Dr. Joseph L. Miller, of Chicago, writes:—

"I am sending a reprint on the 'Treatment of High Blood Pressure.'[3] The more I see of cases with arteriosclerosis, the less I feel convinced as to the etiology except these well-known factors, nephritis, syphilis, gout and diabetes."

Dr. Miller's conclusions are important:—

"1. In moderate doses active preparations of nitroglycerin and sodium nitrite temporarily reduce the blood pressure in the majority of cases of hypertension.

"2. Erythrol tetranitrate causes a more prolonged reduction in blood pressure than nitroglycerin or sodium nitrite, but so frequently causes severe headache that its clinical value is much impaired.

"3. Headache after any vasodilator does not mean that we are getting physiologic effect in the sense that the blood pressure is reduced, as the headache may appear independently of any change in pressure.

"4. A patient's blood pressure may be decidedly affected by one of these vasodilators and uninfluenced by another.

"5. Occasionally the blood pressure of patients with marked hypertension may show very marked fluctuations without apparent cause.

"6. A single sweat reduces hypertension less than a moderate dose of vasodilators. If sweats are given daily, a rather marked reduction of blood pressure, lasting throughout the day, is observed not infrequently. When the sweats are discontinued, the blood pressure soon returns to its previous level."

Dr. C. E. De M. Sajous, of Philadelphia, writes:—

[1] *Journ. of Path.*, vol. x., M'Gill University.
[2] *Montreal Med. Journ.*, June 1907.
[3] Published *Journ. A.M.A.*, May 21, 1910, vol. liv. pp. 1666–1669.

"I am sending you herewith two pages from an article by Professor McConnell in the *Cyclopedia* in which quotations from 'Internal Secretions' clearly summarize my views. This will probably—besides a note copied from 'Internal Secretions,' vol. ii. p. 1560—meet your needs."

"Sajous[1] adopts, in modified form, my theory of hypertension. He holds that arteriosclerosis is primarily due to the presence of endogenous or exogenous poisons in the blood, but does not believe that these poisons act directly upon the vascular walls. They stimulate the adrenals to destroy the said poisons, but this surplusage of adrenal secretion expends its action upon the cells of the vascular walls and is most disastrous in the minute vasa vasorum, the lumina of which becomes obliterated. In consequence, the large vessels are imperfectly nourished and undergo sclerotic and calcareous changes."

Dr. Sajous also sent the following note on "Diet in Arteriosclerosis," from his "Internal Secretions"[2]:—

"The first indication is to reduce the volume of the patient's waste products. The diet requires the greatest attention, the prime requisite being a reduction of the daily aggregate of food. This applies particularly to meats, which constitute, owing to their wealth in nucleins, the bulk of the pathogenic xanthin and hypoxanthin. The total omission of meat—fowl being allowed—and of alcohol from the diet, with reduction of the other foods generally partaken of at regular meal hours, is sometimes sufficient, when persevered in, to arrest the morbid process and initiate convalescence. In severe, though not advanced, cases a milk diet, at least one quart being taken daily during a couple of weeks to rid the blood of accumulated poisons, is necessary before the preceding diet is begun.

"Sir James Barr (*Brit. Med. Journ.*, January 20, 1906) contends that, so far as arteriosclerosis is concerned, the excessive use of nitrogenous food kills more adult men

[1] Guthrie McConnell in Sajous's "Cyclopedia of Practical Medicine," 7th edition, 1912, vol. ii. p. 144.

[2] Vol. ii. p. 1560, 5th edition, 1912.

than alcohol. After witnessing one of the great temperance advocates of the last century dine, he predicted that he would not live three years; the intemperate eater was dead within two.

"Of material assistance in the curative process is the abstention from the use of beverages which stimulate the vasomotor centre, tea and coffee. Pure water in large quantities and diuretic drinks, such as milk and mineral waters, favour materially the elimination of toxic wastes. A pinch of common salt in a glass of milk increases its digestibility and diuretic action."

Dr. William E. Sanders, of Des Moines, Iowa, writes:—

"The concluding remarks of my paper embody essentially my philosophy of its histogenesis."

In this paper on "Atherosclerosis, with Special Reference to the Physiological Development and Pathological Changes in the Intima,"[1] he says:—

"There has been nothing in my cases to suggest that the media plays any part or is in any way altered in the beginning of atherosclerosis. After the process is once well established, hypertrophy of the media occurs, and may, when later impinged upon by the thickened intima, degenerate. The first demonstrable alteration has usually been a thickening of the connective-tissue layer of the intima, and to this, if the condition advances sufficiently, is subsequently added fatty degeneration of the connective-tissue cells, muscular elements and elastic fibres of the deeper layer of the intima.

"The condition is therefore primarily hyperplastic, secondarily degenerative, but in no wise inflammatory. I cannot, therefore, agree with Jores that fatty degeneration is the *sine qua non* of sclerosis of the senile type."

Also, in his reprint on "Primary Pulmonary Arteriosclerosis with Hypertrophy of the Right Ventricle,"[2] he says:—

"The consideration of these seven cases furnished suffi-

[1] *Am. Journ. of Med. Sc.*, November 1911.
[2] *Arch. of Inter. Med.*, April 1909.

cient evidence, I think, to establish the existence of a primary pulmonary arteriosclerosis which must be taken into account as an etiological factor in hypertrophy and dilatation of the right ventricle. The clinical features of the condition cannot be said to be yet sufficiently developed to admit of a diagnosis *intra vitam*, but the careful correlation of clinical symptoms with pathologic studies in a few more cases will, I believe, furnish a rather characteristic picture. The application of the X-ray and the cardiosphygmograph may throw some light on the condition. The fact that a high percentage of these cases has occurred in young individuals without the evidence of previous disease to account for the cardiac condition; further, that the course of the disease has been rather rapidly progressive, and that ordinary cardiotherapeutic measures have been quite ineffectual, should be taken into consideration. The etiology remains, for the present, wholly undetermined."

Dr. William S. Thayer, of Baltimore, has sent me reprints of his well-known article on "The Late Effects of Typhoid Fever on the Heart and Blood Vessels," [1] and "The Cardiac and Vascular Complications and Sequels of Typhoid Fever." [2] These have been referred to elsewhere in the book.

Dr. Augustus Wadsworth, of New York, sends me a reprint on "The Bacteria as Incitants of Malignant Endocarditis." [3] He says :—

"Malignant endocarditis thus develops on the injured or diseased endocardium as a secondary localization in the bacteriæmia or pyæmia of infectious disease. It may be incited by many different species of bacteria, but usually the pneumococcus, streptococcus, staphylococcus or gonococcus is present. It may be associated with any of the infectious diseases of man, but chiefly with pneumonia or some form of sepsis. As a complication of previous disease, malignant endocarditis is of so serious a nature and so often outlives or dominates the parent infection that separate consideration of

[1] *Am. Journ. of Med. Sc.*, March 1904.
[2] *Mobile Med. and Surg. Journ.*, July 1904.
[3] *Med. Record*, December 28, 1907.

it is justified. The exceptionally grave tenor of the prognosis is due to the anatomical situation of the lesion."

Dr. C. W. Watts, of Fayette, Mo., writes:—

"I have for fifty years in active practice given this disease close study, and yet, after all my study and experience, have learned but little new. I think the most important fact is to keep clear in our minds the differential diagnosis between arteriosclerosis and what I would call ossific degeneration of the arterial system, which has quite a different cause and origin. I have been examining soldiers and ex-soldiers since 1862, and have found them all more or less affected—due, I think, to their habits and mode of life—exposure too.

"I am getting very old and feeble, yet I study our profession more to-day than ever before."

Dr. R. L. Wilbur, of San Francisco, Calif., writes:—

"I feel fairly well satisfied that heredity, overwork, prolonged mental distress, overeating, tobacco, syphilis, alcohol and typhoid fever are the main factors in the development of the disease. Freedom from strain, mental and physical, with the use of a vegetable, milk and fruit diet and with the avoidance of nicotine, alcohol and excesses of all sorts offers the best chance for the improvement of patients suffering with symptoms associated with arteriosclerosis, and perhaps interfere somewhat with the further development of the degenerative change in the vessels."

Dr. W. Ophuls, of San Francisco writes:—

"Under separate cover I send you some reprints on arteriosclerosis.

"The histological picture of the lesions suggests to me that it is an inflammatory trouble probably due to chronic infection or intoxication. We know that some forms are due to syphilis and others to chronic lead poisoning. I believe this is about the extent of our positive knowledge. What we pretend to know more are mostly surmises, some with more, most with less probability in favour of them.

"Naturally, I have no convictions in regard to treatment."

In his reprint on "Some Notes on Arteriosclerosis of the

Aorta"[1] there is an interesting discussion of the pathology and of his experiments which did not confirm Thoma's mechanical theory. What he says about etiology is interesting :—

"When it comes to the question of etiology it should never be forgotten that very different causes may produce identical lesions in the living tissues. The number of responses to interference which they possess is quite limited, but the number of agents which may cause such interference is legion.

"From this follows that we should be very careful in making conclusions from the structure of diseased organs as to the cause of the trouble. In this regard I agree fully with Rosenberger ('Statististische Untersuchungen der pathol. anat. Leuesbefunde am Berliner städtischen Krankenhaus am Urban,' Inaug. Diss., Freiburg, 1904), a pupil of Benda's, who says: 'The anatomical diagnosis is certain only so far as it limits itself to characterizing anatomical changes from the normal structure as such. It nearly (why nearly?—the author) always loses in certainty as soon as it draws conclusions from the given picture in regard to the etiological factors at play.'

"The more we learn about chronic inflammatory troubles the more we appreciate how manifold the causes may be that cause them, and in the same way arteriosclerosis of the aorta, although anatomically a unit, is etiologically certainly a very complex affair.

"Clinical evidence, at least, seems to show very plainly that the most varying factors—old age, mechanical irritation (strain, etc.), and chemical irritations (poisons and infectious diseases, syphilis probably more than any other one)—may play a very important rôle in its production."

Another reprint on "Subacute and Chronic Nephritis as Found in One Thousand Unselected Necropsies"[2] is an

[1] *Am. Journ. Med. Sc.*, June 1906.

[2] *Arch. of Inter. Med.*, February 1912, vol. ix. pp. 156–202. Read in Section on Path. and Phys. of Amer. M.A., at Sixty-second Annual Session, June 27–30, 1911, Los Angeles, Calif.

elaborate study and contains much of importance to the subject of arteriosclerosis:—

"It is a well-known fact that entirely normal kidneys are found very rarely, especially in the later years of life. It became necessary, therefore, to establish how far it was possible to eliminate such minor changes from consideration. It might very well have been that just such more or less initial, still undeveloped, lesions could have thrown much light on the histogenesis of the more advanced cases; in fact, the clue to the whole situation might have been just there. A very careful gross and microscopic study was therefore made of the last two hundred kidneys, which confirmed the general impression that these lesions are practically all of arteriosclerotic origin and that they do not help in elucidating any phase of our subject, except in so far as its relation to arteriosclerosis is concerned.

". . . It is interesting to note at this point that, on the whole, general arteriosclerotic lesions develop coincidently with arteriosclerotic lesions in the kidneys, but there is no strict interdependence between the two processes, a fact, however, well established in medical literature.

"The next question which naturally presented itself was whether it is possible to distinguish histologically or otherwise between these common, evidently arteriosclerotic, lesions and the severer lesions which are commonly described as 'chronic interstitial nephritis,' and which are said to produce the 'genuine or primary contracted kidney'; whether, as has been said so often, the kidneys of arteriosclerotics were different from severe nephritis with arteriosclerosis. In spite of some personal inclination toward the latter view, I have been unable to find any evidence to substantiate it. Histologically, the lesions are absolutely identical.

". . . Actual observation then shows: (1) that there may be marked general arteriosclerosis affecting the peripheral vessels without continued hypertension; (2) that the same is more rarely true when the arteriosclerosis is associated with extensive destruction of the kidneys; (3) that, at times, we have long-continued hypertension and cardiac hypertrophy,

followed by cardiac insufficiency, of unknown origin, with little arteriosclerosis and slight renal lesions.

". . . The following would be a short summary of my conclusions.

"At the present time, in many cases entirely too much attention is paid to the kidneys, clinically and anatomically.

"The so-called primary or genuine contracted kidney represents a disease of the kidney which is the result of arteriosclerosis in the terminal arterioles in this organ, is closely associated with general arteriosclerosis, and cannot be properly understood without due consideration of this fact.

"It is difficult to decide the exact interrelation between the renal lesions, general arteriosclerosis, and the hypertension and cardiac hypertrophy which is usually present in these cases. It is only safe to say that the rôle of the kidney lesions in the production of the hypertension has been evidently considerably exaggerated.

"There is some reason to believe that the condition as a whole is a toxic one. So far, however, lead is the only substance which seems to bear any definite etiological relation to the general process.

"Of true primary subacute and chronic inflammations of the kidneys there remain subacute and chronic glomerulo-nephritis, definitely in the majority of instances due to chronic sepsis.

"Closely related to this, etiologically and anatomically, is the subacute and chronic amyloid kidney (the large white kidney of other authors).

"From a combination of these last two conditions there arises the so-called secondary contracted kidney, which in our series was responsible for eleven out of thirty-seven cases of seriously contracted kidneys.

"The etiology of the cases of secondary contracted kidney is not quite so clear as that of the more acute conditions, but it is highly probable that chronic sepsis, in the broadest sense, is an important factor.

"The lesions in subacute and chronic glomerulo-nephritis and secondary contracted kidneys are practically always

hæmorrhagic, and in subacute and chronic amyloid kidneys frequently so.

"The interstitial lesions which are present in these latter conditions begin to develop early, practically simultaneously with the epithelial lesions. It is not very likely, therefore, that they should be secondary to them."

With the first conclusion the author is entirely in accord. Many years he has striven clinically with the gloomy forebodings that have followed the detection of kidney disease, and it is indeed a pleasure to run across the sentence: "At the present time, in many cases entirely too much attention is paid to the kidneys, clinically and anatomically."

Dr. Eugene L. Opie, of New York, sends me a reprint on "Inflammation."[1] His conclusions are important:—

"Inflammation is a process which tends to render harmless an injurious substance; it has its site in the interstitial tissue of the body. This tissue consists of fixed cells and fibrillated substances and is penetrated by closed lymphatic vessels. With inflammation certain cells migrate through the wall of the blood vessels of the part and enter the spaces within the interstitial tissue. Some of those cells are destroyed; others penetrate the endothelial membrane which forms the lymph capillaries, and hence are carried by way of lymph vessels to the regional lymph glands.

"Bacteria and many other injurious substances are attacked and ingested by the polynuclear leucocytes which migrate from the blood vessels. These leucocytes, often injured by the inflammatory irritant, are in turn ingested by large mononuclear cells (macrophages) which quickly appear at the site of inflammation. The origin of these mononuclear cells is still undetermined. Ingestion of polynuclear leucocytes and other cellular material is begun at the site of inflammation and completed in the regional lymphatic nodes.

"The ability of phagocytic cells to remove injurious material is dependent on the possession of proteolytic enzymes. Peculiar to the polynuclear leucocytes is an

[1] *Arch. of Inter. Med.*, June 1910, vol. v. pp. 541–568. Presented before the Harvey Society, New York, February 19, 1910.

enzyme which, like trypsin, exerts its digestive action in an alkaline medium. The serum of the blood contains an antienzyme which restrains the action of this enzyme should it be set free from disintegration of the leucocytes; the action of the enzyme is thus limited to the locality in which it accomplishes its proper function, namely, within the cell. When enzyme is set free in such quantity that it overbalances the antienzyme of the exuded serum, suppuration occurs, for the purulent exudate has, in virtue of its unrestrained enzyme, acquired the power to soften and erode the adjacent tissue.

"The mononuclear phagocytes which appear in the late stages of acute inflammation, the similar cells which appear in the regional lymph nodes, and the cells of similar structure which constitute the greater part of tuberculous tissue contain an enzyme which, like pepsin, digests in the presence of acid. Such phagocytes are active at the site of inflammation, but their work is completed in the regional lymphatic nodes.

"Inflammation is the process by means of which cells and serum accumulate about an injurious substance and tend to remove or destroy it. This process does not include the regenerative changes which replace injured tissue by newly formed parenchymatous elements or by new interstitial tissue. Present nomenclature of chronic disease contains many terms which are inconsistent with knowledge of the underlying disease. Terms such as 'parenchymatous nephritis,' 'traumatic myelitis,' acute 'hæmorrhagic pancreatitis,' are applied to conditions which have not primarily the characters of inflammation; the term 'chronic inflammation' is applied to complex morbid changes (*e.g.*, cirrhosis, chronic nephritis, myocarditis, arteriosclerosis, etc.) in which inflam matory processes have an insignificant part."

Dr. Horst Oertel, of New York, writes as follows:—

"An attack of influenza has prevented my writing to you before this.

"I have not published any special study on arteriosclerosis, but I have touched upon the subject in my

monograph on 'Bright's Disease,' particularly pp. 169–176, and in an article on 'The Determination of the Cause of Death,' etc., published in the *New York Medical Journal*, July 15, 1911.

"I think one should endeavour to draw a sharp line between arterio- or athero-sclerosis, which I agree with others is essentially a wear-and-tear process, and the inflammatory changes of the arteries. Unfortunately, that does not always seem possible, and is here as elsewhere the source of confusion. The matter is particularly complicated in the smaller arteries, and very difficult in arterioles and capillaries, as, for instance, in the kidney.

"There is as yet no uniform opinion about the pathogenesis of arteriosclerosis. It is certain that in larger arteries it is associated prominently with an abundant formation of elastic lamellæ of the tunica intima, which obliterates the distinction between the tunica intima and media and exhibits a strong tendency towards fatty changes and necrosis and calcification. The tunica media become similarly involved. The opinion of the best German authorities (Thoma, Albrecht, Marchand, Jores, Romberg, Kaufman) is that the disease is primarily of internal origin and may be traced to the physiological increase of elastic fibres in the growing and ageing organism. This physiological adaptation has, of course, a limit, due to age and requirements demanded of the elastic tissue and developmental or hereditary influence. They lead to loss of elasticity, overstretching degenerative changes, internal connective tissue, hyperplasia and secondary involvement of the media.

"There are others, however, who, as you probably know, see the first changes in weakening and necrosis of the media, and regard the internal changes as compensatory in character.

"I believe it quite possible that both developments may occur, but that the medial origin and early involvement seems to be more frequently the direct result of toxic or infectious influences (adrenal diphtheria, toxin, etc.), probably acting through the vasa vasorum. These changes may therefore be more closely related to the inflammatory lesions, or possibly stand between the true wear-and-tear arteriosclerosis

and the true inflammatory lesions of arteries. As I said before, it is in the smaller arterioles and capillaries, as in the kidney, very difficult to say what is arteriosclerotic and what is inflammatory. Moreover, it is very possible to have a number of conditions interact. This may be the case in the arterial changes which are so prominent in one type of contracted kidney. How far these are purely arteriosclerotic or inflammatory—that is, directly of toxic origin—is questionable. I hope your own studies may throw some light on this complicated problem, and I shall be very glad to read your monograph on the subject."

Dr. W. W. Beveridge, of Asbury Park, New Jersey, has sent me a paper on "The Influence of Sleep on Arteriosclerosis,"[1] from which the following seems pertinent:—

"When I say arterial sclerosis I speak of it, and shall describe it, as simply typical of the changes taking place with age. Thus the subject matter of this paper will be dealt with in the most general way possible. What I shall say in a descriptive way about the pathological changes or degenerative changes taking place in one organ or tissue or set of cells, I believe to hold true of the organism as a whole. I shall describe more especially the changes taking place in the vascular system, not because they are exclusively characteristic in the circulatory organs, but because by reason of the general destruction of blood vessels these changes are so admirably shown. It might be easy to demonstrate a structural change in the liver tissue, but, as the damaged hepatic cell is not found elsewhere in the body, it could not be deduced that the process was a general one, so that structural changes described in the vascular system are only assumed to serve as an illustration of changes taking place in all of the tissues of the body.

"The class of patients who exhibit the signs of early degeneration, as a rule, are nervous individuals, either by nature, occupation, or habits of life. Generally, they are poor sleepers, or their natural slumber is very much disturbed by worriment or environments not favourable to

[1] *Virginia Medical Semi-Monthly*, July 1909.

natural repose. The tendency of our modern life is to live at a fast rate, and to reduce to a minimum the hours of repose, thus not only subjecting the organism to unnatural strain, but depriving it of its physiological repair. Necessarily, early decline results. This is clearly shown by the class of individuals who lead a more regular life. Among the agricultural classes, who retire regularly as a rule, and whose sleep is not disturbed by the noises of city life, long life is the rule, and marked secondary changes are less frequently seen in early life."

Dr. B. S. Oppenheimer, of New York, has kindly sent me a reprint by Leo Buerger and Adele Oppenheimer on "Bone Formation in Sclerotic Arteries."[1] The summing up is interesting:—

"Summing up our own view of the process we may say that by virtue of some stimulus, be it an organizing thrombus, an attempt at vascularization of obliterating pathological intima, or possibly the presence in the diseased mesial coat of lime alone, a penetration of the media with vessels takes place. This is followed by the proliferation of young connective tissue in the media which comes into contact with the lime; at such points of meeting the young connective tissue cells manifest a new function by producing the ground substance of true bone."

My friend, Dr. Judson Daland, of Philadelphia, sends me a reprint,[2] and writes the following opinion:—

"I make a clear, clean-cut differentiation between arterial spasm, atheroma, syphilitic endarteritis and arterial sclerosis.

"Most of the cases of arterial sclerosis that I see in my wards at the hospital are due to: (1) Excessive physical toil, especially in those occupations requiring heavy lifting, in association with exposure to intense heat alternating with ordinary room temperatures. (2) Another group is in relationship to alcohol and intestinal toxæmia. (3) Still another group is dependent upon primary renal disease or

[1] *Journ. Exper. Med.*, 1908, vol. x., No. 3.

[2] "Clinical Diagnosis of Arterial Sclerosis," *Monthly Cyclopedia of Practical Medicine*, 1907, vol. x. p. 145.

renal insufficiency, causing persistent hypertension extending over many months.

"In private practice the majority of cases of arterial sclerosis seem to be due to long-continued overstrain of the nervous system, and is particularly observable in those of a neurotic temperament following occupations necessitating the assuming of great responsibilities. For example, it is frequently met with among surgeons. Naturally also, cases similar to those observed in the hospitals come under observation.

"Another group includes children as early as five or six years of age and on up to adolescence, of a neurotic temperament and born of highly intelligent and neurotic parents. These cases seem to be examples of congenitally weak cardiovascular systems, from which I have carefully excluded congenital syphilis.

"Still another group occurs in young college athletes, due to excessive over-physical exertion.

"I have observed that hypertension in arterial sclerosis is not the rule, that exceptions occur and that the disease may exist with hypotension.

"When arterial sclerosis occurs in machinists, stokers, labourers in locomotive works, coal miners, etc., I view the disease as due to the occupation. In this group of cases, if the occupation is adapted to their physical requirements, the disease remains stationary. This same fundamental truth is applicable to those suffering from the cardiovascular manifestations of overstrain of the nervous system. I have occasionally inclined to the theory that in certain cases of arterial sclerosis in neurotics it is possible that the suprarenal glands over-functionate.

"One chapter in arterial sclerosis which in my judgment is frequently overlooked and ignored is the relationship existing between recurrent and more or less continuous varying degrees of intestinal toxæmia. I am of the opinion that long-continued intestinal toxæmia is capable of producing arterial sclerosis; and if this be true, it is therefore manifest that the discovery and removal of this toxicity prevents

progress of the disease and permits the body to adjust itself to that which already exists, which it ofttimes does so successfully that the patient shows all the evidences of good health."

Dr. C. N. B. Camac, of New York, sends me a reprint of his well-known article which appeared in the *American Journal of Medical Sciences*, May 1905, on "Some Observations on Aneurysm and Arteriosclerosis." He gives several very interesting charts, three of which I have quoted below.

"CHART IV.

"THEORIES. NINETEENTH CENTURY. (NOT CHRONOLOGICAL.)

I. Inflammation theory	Many observers.
Pathology of inflammation not clearly understood.	
II. Humero-pathological theory, 1844 . .	Rokitansky.
III. Pathology of inflammation . . .	Cohnheim.
IV. Mechanical theory	Traube.
V. Interrupted nutrition theory . . .	Rindfleisch.
Question 1. Nutrition of vessel wall?	
„ 2. Passage of leucocytes into vessel wall from lumen of vessel or from vasa vasorum?	
„ 3. Nutrition of non-vascular intima?	
VI. Passage of leucocytes from lumen hypothesis	Gotte, Koester, Stronganow, Talma.
VII. Nutrition from vasa vasorum only, demonstrated	Durante.
VIII. Passage of leucocytes from vasa vasorum to non-vascular intima, demonstrated .	Virchow, Koester.
IX. Compensatory process and molecular theory	Thoma.

For further details see Professor Jones' monograph on 'Arteriosclerosis,' to which I am indebted for much valuable information.

"CHART V.

"NOMENCLATURE. NINETEENTH CENTURY. (NOT CHRONOLOGICAL.)

Arteriosclerosis	Lobstein.
Arteritis	
Atheroma	Haller.
Arteriocapillary fibrosis	Gull and Sutton.
Periarteritis	
Periarteritis nodosa, 1866	Kussmaul.

Obliterative endarteritis, 1876	Friedlander.
Endarteritis, chronica deformans	Virchow.
Endarteritis nodosa or conscripta diffusa	Councilman.
Mesarteritis	Trompeter-Krafft.
Angiosclerosis	Thoma.

Subdivisions of aneurysms not given, as those refer more especially to gross than to histological appearances.

"CHART VI.

"EPOCHS.

Prior to 400 B.C.	Complete gnorance.
400 B.C. to 300 A.D.	Beginning of accurate observation. Anatomical facts.
300 to 1500	Decline of anatomic study. Superstition and prejudice.
1500 to 1600	Revival of anatomy. Anatomical laboratories.
1600 to 1700	Pathology. Pathology (Gross). Pathological laboratories. Symptomatology and morbid pathology.
1700 to 1800	Methods of physical examination. Clinical.
1800 to 1900	Pathological histology. Bacteriology. Physiological chemistry.

Each of the above represents the dominant consideration of its time."

Dr. T. Stuart Hart, of New York, sends me a reprint on "Paroxysmal Tachycardia."[1] His conclusions are interesting, as this is a very common complication of arteriosclerosis and is due to damage of the heart by the same agent which produces the disease:—

"The case of paroxysmal tachycardia presented offers evidence of a considerable degree of damage to various portions of the myocardium:—

"1. Damaged auricular tissue (abnormal P complex, dropped beat).

"2. Damaged junctional tissue (lengthening of P-R interval).

"3. Damaged ventricular tissue (abnormal Q RS com-

[1] Published in *Heart*, vol. iv., No. 2, November 30, 1912.

plex, ventricular premature beats of two types, periods of tachycardia, composed of ventricular premature beats, alternation).

"The ventricular tachycardia shows a remarkable parallel to the conditions produced in a dog by Lewis when he tied the descending branch of the left coronary artery; the series of premature beats of ventricular origin, the auricular response to the ventricular pace-maker and a blocking of a part of these reversed stimuli all have their counterparts in the case here presented.

"It seems quite probable that in this case we are dealing with myocardial changes due to coronary disease, possibly following a syphilitic infection and the prolonged use of alcohol."

Dr. G. S. Warthin, of Ann Arbor, writes:—

"I believe that in many cases of arteriosclerosis the primary lesion is in the intima, and that fatty intimal degeneration, cloudy swelling and necrosis may be due to bacteria localized upon the intima, or poisons. I have had a number of interesting cases of beginning otitis media in young children with marked arteriosclerosis and beginning atheroma of the aorta. In congenital syphilis I have found localized changes in the intima of the aorta associated with localized colonies of spirochætes. Various stages have been found, so that I am sure that the picture of sclerosis and atheroma may arise from such primary lesions as fatty degeneration due to intoxication and infection. I also believe that some forms of syphilitic aortitis are the result of syphilitic diseases of the smaller vasa vasorum, the condition being primary in these, and not upon the intima of the vessel, although as a result of the obliteration of these the intima soon degenerates and hyaline change takes place. I look upon the prevention of infection and intoxication as the most important measures against the development of sclerosis. One other point of interest: I have seen a number of young men with severe cases of typhoid fever develop a marked general arteriosclerosis during the year following recovery, these young men becoming prematurely senile. It is, of

course, difficult to eliminate familial tendencies in such cases. Next to syphilis, I look upon typhoid fever as one of the most important infections leading to arterial degeneration and subsequent sclerosis."

Dr. E. G. Cutler, of Boston, writes emphasizing the importance of diet. Speaking of the improvement of diet he says: "You have doubtless seen some really very striking cases of this, as I have."

Dr. Hugh A. Stewart, of New York, sends me an interesting reprint on "The Mode of Action of Adrenalin in the Production of Cardiac Hypertrophy."[1] Cardiac hypertrophy is not as straightforward an example of a mechanical result as I once supposed. His conclusion is very interesting to me:—

"It would appear, then, that the enlarged heart of the rabbit produced by adrenalin injections is due to the increased weight of an abnormal myocardium. The drug produces a metabolic disturbance in the muscle fibre, of the chemical nature of which we are at present ignorant, but which results in an increase in volume associated with degenerative changes. It is therefore not a true hypertrophy in the sense that the fibre in all its elements is enlarged and capable of more work, but rather that the heart is an enlarged organ whose functional capacity is below normal. This enlargement cannot be regarded as the result of increased work induced by adrenalin, and we are therefore forced to the conclusion that the so-called hypertrophy is merely an increase in mass resulting from the action of a toxic agent."

Thus, the author's friends in the profession have covered the subject with a considerable degree of completeness, but it has been necessary to omit much of great interest. For instance,—so much valuable information was contributed concerning the relationship of arteriosclerosis to the eye that it will probably be the subject of a separate monograph. It is evident that there are many thinkers in America who are far from a belief in the purely mechanical theory of arteriosclerosis, and who have much regard for a chemical theory in one form or another.

[1] Published *Journ. of Path. and Bacter.*, vol. xvii. (1912).

XV

PROLONGATION OF LIFE IN ARTERIOSCLEROSIS

There is no forecordained limit to the prolongation of life in arteriosclerosis. Compensation keeps pace with structural change, and no one can say how long this neck-to-neck race can proceed.

I see a woman from time to time who is nearing her eightieth year, whose blood pressure I have watched increase for the last ten years from 180 to 270 mm. Hg. Under careful supervision a heart showing loud murmurs has nevertheless been able to compensate, so that now in March she is making her plans for next summer.

As a matter of fact, it is hard to recall one example of a failure to compensate for the changes of arteriosclerosis in the absence of toxæmia or negligence of the laws of health applicable to the particular person's condition. When accidents have occurred the matter is more difficult, but there is not one of us who cannot recall long years of life with usefulness and happiness even after the onset of partial paralysis when a suitable regimen has later been pursued.

Decompensation in arteriosclerosis means a failure of blood-pressure-maintaining forces (often but not always cardiac), and is as much a fact as broken compensation is in valvular disease.

There is a certain periodicity in attacks of decompensation in certain individuals that makes anticipation and prevention possible. They often come at the same time of the year or under similar conditions. The days, months and years have their physiologic tides that are worthy of study. A course of treatment in anticipation of trouble will often

prolong life and good condition. It has seemed to me, in the auto-intoxication that so often goes with arteriosclerosis, that the month was a critical period. Hence I urge upon all sufferers, after they have submitted to proper cure, the monthly dose of castor oil. The spring of the year has always seemed to me to bring more than its own share of attacks of decompensation.

Foresight is the greatest element in the prolongation of life in arteriosclerosis. Few of us have witnessed the natural maturation of cardiovascular disease. When trouble has come it is through the occurrence of complications and accidents.

One of the reasons that medical literature so often poorly reflects medical experience and knowledge is that all writers treat medicine as a systematized science, without regard to the relative importance of conditions as judged by the frequency with which they recur in actual human experience. In this book we have sought to avoid this in a measure by perhaps wearisome repetition of the more frequent experiences and the essentials of treatment.

A typical example of the commonest form of arteriosclerosis was Mrs. J., who came to me because she believed I had helped a friend who had suffered from a less serious condition.

She was sixty years of age. Her father died at the age of fifty-three; her mother at fifty-six. She had one uncle living to the age of ninety-nine. Her husband was living and well, and she had three children. She had recently lost a daughter under distressing circumstances.

She had had no severe illness, but for two years had suffered from præcordial distress, shortness of breath, and on two occasions had had attacks which might be called angina pectoris.

There was no definite cause for her condition that could be traced in any infectious disease or worry, except the death of her daughter, which was too recent to explain her entire trouble.

At the birth of a child twenty-five years before she

had had convulsions, but knew nothing of any kidney disease.

She was a tall, stout woman, and said that all her life she had slept well, had had a good appetite, had been moderate in the use of tea and coffee, and had passed the menopause without special trouble, though she was quite nervous at this time.

On examination her systolic blood pressure was 199 mm. Hg; the arteries were considerably thickened; the heart dilated, showing a loud systolic murmur at the apex and a double murmur over the aortic area. There was some œdema of the legs, but the region of her liver was not tender and the lungs were clear. The pulse rate was 120, but regular.

When she came under observation she was on a general, and it might be added a generous, diet.

Mrs. J. was put upon a suitable regimen and did very well, though the blood pressure was not materially reduced. The œdema disappeared. Her præcordial discomfort was relieved and she returned to her home. The prolongation of life in such a condition is absolutely dependent upon a strict regimen, much stricter than is generally ordered.

Arteriosclerosis is a condition without symptoms—a remark that is frequently repeated, but cannot be too much emphasized. It should be possible to detect cardiovascular disease before the stage of severe cardiac pain has developed, though præcordial distress in lesser degree is what, more often than anything else, brings these people under observation.

An extraordinary example of the same type where a diet was followed with continuous satisfactory results was Mr. K., who was referred to me by Dr. John J. Dooling, of Brooklyn.

Mr. K. had a severe attack of pain in the chest five years before, which had kept him in bed for six weeks. His last attack had been three weeks before coming under observation, and at that time he complained of shortness of breath on exertion, swelling of the feet and insomnia.

His father and mother were both living and well. He had a wife and five children. He was very tall; weighed

230 pounds; declared that he slept poorly; had a poor appetite; used tobacco to excess; used some whisky and brandy—five or six drinks daily. He was habitually constipated and used saline laxatives freely.

Both he and his physician took a most discouraging view of his prospects, and were very much surprised when told that he could do better with a proper adjustment of food and the avoidance of the things which were doing him harm; among these could be placed the abuse of salines, the excessive protein diet, alcohol and tobacco.

He was given several full doses of castor oil at intervals; eggs, fish and meat were prohibited, and he was told to eat sufficient cheese to supply the necessary nitrogen in his food. Nothing else was done for him, except that he was given to understand that his only hope lay in diet.

He did very well for a time, but neglected himself again, and after a couple of months he had an attack of fibrillation of the auricle. This was controlled by digitalis, but has remained permanent ever since, necessitating the use of digitalis. He has become accustomed to his regimen, and except for an occasional lapse is doing very well at the present time and is carrying on his business.

The value of strict adherence over a long period of time to a definite regimen is shown in the history of Mr. G., referred to me by Dr. Gordon K. Dickinson, of Jersey City.

Mr. G. was a gentleman sixty-seven years of age who had recently undergone extreme business worries, and was found with very rapid heart action, shortness of breath on exertion and swelling of the limbs. The systolic blood pressure was 220 mm. Hg; the hæmoglobin was 100 per cent. The heart sounds showed a double aortic murmur and a mitral systolic, both probably due to hardening of sclerotic origin. There was no known cause for his arteriosclerosis.

The bowels were cleared out thoroughly with castor oil, and strontium bromide was given in moderate quantities on account of the extreme restlessness. Eggs, fish, meat and soups were strictly prohibited from the dietary, and out-of-door exercise was ordered. Castor oil was given once a week.

This regimen was continued for some months, during which time Mr. G. did very well.

Four months later he so far improved as to relax his diet and overstrain himself by rowing a boat a long distance against the tide. Now he had a severe attack of suffocative œdema and a return of the rapid heart action. At this time he was in the country, and I saw him in consultation with Dr. James J. Reed, of Sea Bright, N.J. I advised a return to the strict regimen, and he very soon got around again.

About six weeks later, on the occasion of an extreme worry, he developed a return of the dyspnœa and a tendency to those attacks in the early hours of the morning. His

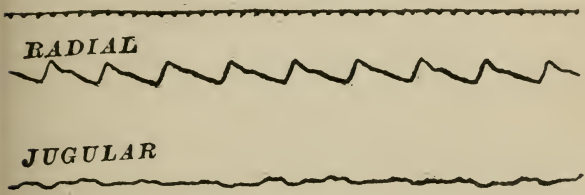

Fig. 15.—Case of Mr. G., after digitalis.

blood pressure at this time remained 220 mm. Hg. The urine contained a large quantity of indican, an occasional faint trace of albumin and a few casts.

In the emergency of the suffocative morning attacks, in spite of the high blood pressure, I decided to digitalize his heart. This was accomplished by giving two drachms of the infusion of digitalis every four hours until distinct digitalis symptoms developed (as shown by the accompanying tracing).

Then the drug was reduced to a single dose daily, and continued without interruption. Under this continuous use of digitalis the pulse finally settled itself at an average of fifty-six, sometimes getting much slower.

The gentleman's general condition has remained good since then, and he has been able to be out every day and

attend to some of his affairs, so it was deemed unwise to alter the plan up to the present time.

At the last examination the hæmoglobin was found to be 100 per cent.; blood pressure, 220 mm. Hg; pulse, 56, and regular; bowels, sleep and appetite satisfactory. The aortic murmur was less marked than formerly, indicating that possibly some of the sound was due to dilatation. General condition good. Out every day, with an occasional visit to the office.

It may be found that the prolongation of life will in this instance depend upon the continuous use of digitalis.

XVI

THE PREVENTION OF ARTERIOSCLEROSIS

Every observing person knows that arteriosclerosis is constantly developing among persons past forty who are otherwise healthy. Surprise is often expressed that this man or that, in spite of what seemed to be right living, has become a victim.

The slightest consideration leads to the belief that there is some active though hidden agent working to cause the hardening of the arteries, and a little examination shows that the causes are not those usually assigned. The healthy old drunkard disproves alcohol as a cause. Rheumatism more often attacks the young, and in later life generally spares the blood vessels. Men who really overwork are not as numerous as is often thought, and worry, while a great cause of heart disease, may be indirect in its effect.

The remark is constantly appearing in the literature of the day that circulatory disease, as shown by statistics, is more frequent than formerly. Tuberculosis has for its victims the most attractive of the youth of the land, but arteriosclerosis claims the best and most successful of those past forty. Much attention is being directed to tuberculosis, because its cause and progress have become matters of public knowledge. The victim of arteriosclerosis, however, still too often goes for months and years without intelligent treatment, because no one has pointed out the danger signals and because the interest in germ disease has absorbed everyone's attention.

Hardening of the arteries nine times out of ten is, I believe, due to disturbances of the chemistry of the body. The

prevention of hardening of the arteries must be accomplished by a proper regulation of metabolism, particularly that pertaining to the intestines and liver. This is accomplished through diet and exercise, through the administration of certain well-defined remedies, and the limitation of nervous strain, than which nothing is more potent to upset the bodily chemistry. The technical chemistry involved is difficult and complicated in the extreme, but not necessary for practical results.

The truth is not all found in popular explanations with such trite names as *intestinal putrefaction,* but is found in the ultimate destination of food substances and their relation to the cells.

The tendency to arteriosclerosis in otherwise healthy individuals can be detected better by a general physical and chemical examination of the body than by an examination of the vessels themselves. By the time the vessels show changes, as appreciated by the sufferer on account of pain or shortness of breath, irretrievable damage has been done. Then the chemical vice has become so deeply seated that an extreme regimen is necessary, while in the early stages a slight modification of diet and hygiene can check the trouble.

It is often remarked that the consumptive is fortunate who has a severe hæmorrhage early in his disease,—that thoroughly convinces him of the necessity of treatment. In the beginning, arteriosclerosis, unfortunately, has no symptoms, and the changes in the organs themselves are such as can only be detected by the most expert examination. Fortunate is the individual if the disturbing chemistry of the body leads to pronounced suffering in the direction of recurrent headaches, biliousness, or toxæmia before the heart and blood vessels are damaged, because these things may lead to treatment and prevention.

The prevention of arteriosclerosis can only be accomplished infallibly when there is a periodic examination at stated intervals by an expert clinician, leading to early and proper courses of treatment to counteract the tendency before damage is done.

Some of the large life insurance companies are now

examining for an underlying chemical cause of arteriosclerosis in otherwise healthy persons who apply for large policies, and yet one of the saddest examples that I ever witnessed of chemical damage to the heart and blood vessels was in the medical officer of one of these very companies.

These conclusions are the result of work devoted exclusively to the practical care of arteriosclerosis, but I would urge upon my colleagues who are privileged to do laboratory research the vitally important bearing of their work upon the life and well-being of mankind at the most useful period of life.

The prevention of arteriosclerosis brings up a problem that has not received the attention it deserves.

However much constant observation may tend to the contrary, each individual considers himself immune to the disease, so the victim of arteriosclerosis seems to himself a special victim of Providence.

So little is the prevention of arteriosclerosis believed to be possible that in the International Congress of Hygiene I was the only one to read a paper on this subject, and presented the ideas included in this chapter; nor, indeed, does the topic seem to have occupied much of the minds of medical men. I judge this because an extended experience in addressing medical societies on this topic has shown that but few physicians have formulated any ideas as to the causation of cardiovascular disease, and hardly any have understood its prevention. More than three out of four of the physicians who were asked their opinions for the chapter on "Opinions of American Physicians" said they had formed none.

There are three conditions of the medical mind that are met with. Some have poorly developed, but on the whole correct, ideas concerning the subject; others have erroneous ideas; but worse than all, many have formed no idea on the subject at all.

Read the literature on cardiovascular disease and you find a list of indefinite and even absurd causes given for the most serious affections. You find tobacco given as the usual cause

of arteriosclerosis, while in fact it is the cause in but few. You find alcohol receiving undue blame. Then again, syphilis and infectious diseases are blamed, but they can only account for a few. The damage of rheumatism is very definite and well known. The greater number of sufferers have none of these things, and have presented a profound mystery to thoughtful men in all times, while the less thoughtful and careful writer and practitioner has accepted the inadequate causes mentioned above without question. One of the most brilliant writers on the heart of the last half-century (David Wooster, of California) says:—

"Permanent disease of the heart (and blood vessels) is derived from the deposition, in some portion of it, of analogous tissues; that is, analogous to healthy tissues. The cartilage and bone deposited in the heart and arteries is analogous to cartilage and bone in the joints, though not exactly like, either chemically or physiologically. It is disease of the heart caused by these deposits, and that caused by deposition of fat in the substance of the heart and also that caused by atheromatous deposits, either alone or in company with cartilage and bone, with which we are most concerned.

"We are accustomed to say that heart disease comes of itself. If one has an inflamed eye, we say that the eye has been recently hurt, or exposed to a cold wind or some contagion; if one has a fever, we say he has been exposed to its cause recently. We recognize these causes, and always refer to them for the solution of the phenomena of acute affections; not so with chronic diseases, we are apt to say they come of themselves; and yet they have causes as definite and appreciable as an intermittent fever or a pneumonia, but they are so long in acting that we keep no record of them, and do not seek them until the disease takes form and place.

"We do not know why this premature old age seizes on the heart rather than the lungs or liver; why it does not at the same time cause wrinkles, and parchment coloration of the skin. These negative inquiries are unprofitable, and if

answered would not elucidate the unsolved problem: why are analogous growths deposited in the heart at all? They are deposited because one dissipates. But why does dissipation cause them? Because it induces old age? But why does old age cause these deposits? Because nutrition is defective, and hence the form elements are dwarfed and imperfect. But why is nutrition defective in old age? Here the oracle returns no longer any satisfactory answer, and hence the first question remains unanswered and unanswerable; that is, we do not, and probably never can know why analogous growths are deposited in the heart at all."

Much closer to the truth, but not within its light, are the large number of older authors who lay great stress on gout as a cause of hardening blood vessel disease in those past middle life. These at least recognize a chemical cause.

My own belief is that most cases of cardiovascular disease developing past middle life are instances of chronic food poisoning, and that the condition known as intestinal putrefaction, though it has an important bearing on the matter does not seem to me as straightforward a cause of the disease as many at the present time maintain.

If we look about us in the world, we see many examples of persons who are poisoned by particular articles of food, that is, poisoned in a way that makes them immediately and uncomfortably ill. Many other people eating the same food escape harm, and we say that the people are idiosyncratic to that particular kind of food that renders them ill. More technically, we say they have become sensitized.

Arteriosclerosis seems to me often to develop as a result of damage done by some material derived from food to which the tissues are idiosyncratic. The damage often comes about gradually without disagreeable symptoms. The substances at fault are in all probability split products derived from the breaking down in the intestines of nitrogenous food derived from eggs, fish, meat and soups. Which of these foods supply the product doing the damage can only be determined by experiment with the individual under observation. We cannot lay down rules for everyone. Thus, I

have observed examples in which almost fatal heart disease developed from the excessive eating of fish; many others are damaged by an excess of eggs; and still a greater number by meat. When the process is started, even a very small quantity of the offending food can keep the damage going on. This is analogous to the phenomena that pertain to bacteria.

Of late years it has become fashionable to consider this whole matter one of intestinal putrefaction. This seems to be going too far, but it is a fact that the chemical manifestation of the condition known as intestinal putrefaction, as shown by indican in the urine, is a usual accompaniment of food poisoning. I have seen very bad cases in which it was absent.

The early signs of arteriosclerosis are those of protein sensitiveness of the heart leading to toxicardia and disturbances of heart action, in the form of rapidity, premature contractions, a sense of oppression, pain over the heart, shortness of breath on exertion and poor circulation.

A similar poison may attack the nerves, and cause neurasthenia or recurrent headaches. The combination of headaches and palpitation is quite common.

These symptoms have often been described as dyspepsia, without any very definite idea as to what was meant by the term. Dyspepsia in itself hardly ever affects the heart. It is the products of protein food that do this.

The study of many thousands of specimens and of a great number of patients leads me to the belief that the natural course of development of arteriosclerosis is as follows:—

At first the person has no symptoms. Arteriosclerosis in its early stages has no symptoms, no acidity of the stomach, no constipation—nothing. The first thing that is noticed, if there is an accidental examination of the urine, is the presence of albumin or the derivatives of indol, skatol or phenol—one or all of the putrefactive group. The man has no symptoms until one of several things happens. After a long time he may have an attack of hemiplegia, or quite early he may have an attack of neurasthenia (for food poisoning affects the nerves); then the condition is recognized. In

the latter case, he undergoes treatment, is sent away, and frequently escapes arteriosclerosis. If he happens to escape nervous symptoms, he goes on for a good many years, perhaps excreting indican (being the index of a disordered metabolism), and then after a while these products damage the kidneys.

Then albuminuria develops and a few hyaline casts appear. These are often discovered by life insurance examiners, which is a very fortunate thing. If this is not the case, the myocardium often becomes involved. The arteries are visibly affected last. So some trouble with the myocardium attacks the person, he has a soft murmur, and slight dilatation of the heart; or else præcordial pain; which is explained by the reflex protective phenomenon, which consists of the fact that whenever an unstriped muscular tissue is unable to do its work, it irritates that level of the spinal cord, and the sensory nerves passing through it are irritated so that the nerve gives rise to pain that is felt in the brain and referred to the distribution of the nerve. The little boy who eats the green apple has the same kind of pain analogous to the failure of the heart muscle which is poisoned by a foreign protein group and has difficulty in doing its work.

If the victim escapes cardiac symptoms and neurasthenia, and albuminuria is not discovered, then last of all the blood vessels are gradually affected. The kidneys are also damaged and unable to do their work, except with additional blood pressure; so when the kidneys are unable otherwise to do their work properly, blood pressure is raised. It is a compensatory phenomenon. When the blood pressure is raised, the heart becomes hypertrophied to more easily keep up the blood pressure, and the blood vessels themselves become hypertrophied for the same reason. We have at first the hypertrophy of the blood vessels and later the deposit of fibrous tissue.

I should say that in the early stages of this condition, when the toxic elements are active, and the structural changes have not taken place in the kidneys enough to

increase blood pressure, these persons have low blood pressure because of the disturbances of tone of the heart muscle and the muscular elements of the blood vessels. The moment the kidneys become at all incompetent, there is a tendency to high blood pressure.

Thus we have a vicious circle—we have the hypertrophied heart and blood vessels and the damaged kidneys. The kidneys and blood vessels are progressively damaged, and at the end of twenty-five or thirty years, the man who became sensitive to some protein has well-developed Bright's disease, with hypertrophied heart and blood vessels, and liability to terminal apoplexy, uræmia, or cardiac dilatation. This is the history of arteriosclerosis.

So much for a general consideration of the subject, which is necessary to the logical conclusion with reference to prevention.

The importance of intestinal putrefaction has been dwelt upon by many writers, and is no doubt a long step in the right direction. But an appreciation of sensitization must be added. A low-protein diet seemed, at the time when it was advocated, a great advance and accomplished good, even if administered under a misconception. I now believe in and advocate the *few-protein dict*, which seems to justify itself by the results I have observed. It is founded on the belief that arteriosclerosis is not caused by a high-protein diet as such, but by the action of some protein derivative of some particular protein food, or foods, to which the individual attacked is idiosyncratic. I believe, as mentioned above, that conscious poisoning of many individuals by particular protein derivatives points in the direction of sensitiveness in the modern sense.

The individual eating the great variety of protein foods found in a modern dietary is laying himself open to the attack of many different kinds of amino acids and other split products, any one of which may be the one which is to do him harm. If he cuts out one-half of his proteins, he is by that much safer. If he is willing to do with a single protein, he is almost certain, on the theory of chances, to escape that which will do him damage.

In Dr. Chittenden's laboratory, it has been shown that animals get along fairly well through several generations on single proteins. I have also abundantly proved that human beings sick with arteriosclerosis can not only stand a single protein food but are improved by it.

This theory explains to me several things that have always been obscure: in the first place, the relative unfruitfulness of the quantitative investigation of the nitrogen intake and excretion in disease. The matter being one of *quality* and not of *quantity*, the reason becomes plain enough.

The fact that the poisoning is not the same in every person, nor, indeed, often in any two persons, explains the great variety of different combinations of symptoms. In one patient, migraine is very prominent; in another, pain derived from the heart muscle; in another, the kidneys are easily affected; in others, the nervous system is profoundly involved.

Prevention of arteriosclerosis is a matter of dietetic management and the avoidance of all those things which may upset the chemistry of the body. The chemistry of the body can be upset by nerve strain, anxiety and stress; it can be upset by the abuse of drugs, particularly saline laxatives and mineral waters; it can be profoundly upset by accidental food poisoning. Nor should we forget the neglect of rest and exercise. I have traced several examples of sensitization and damage from proteins to severe illness such as dysentery and jaundice.

In the presence of any suspicion of commencing trouble, a course of treatment should be taken consisting of serial doses of castor oil and a temporary diet from which eggs, fish, meat, fowl and soups are excluded, cheese being allowed to supply nitrogen in the safest form. When the danger seems to be past, the protein food should be added one article at a time, as, for instance, chicken once a day, and later eggs or fish; but the number of kinds of protein food must be kept within limits according to the condition of the individual. At first the person may be idiosyncratic to only one or two forms of food. A person with advanced arterio-

sclerosis is often idiosyncratic to most forms of protein food. A very thoughtful physician, Dr. Edward E. Cornwall, of Brooklyn, said in a recent article:[1]—

"In this connection I should like to call attention to the value of dietetic treatment in the prophylaxis of cardiovascular disease. Many individuals are destined from their birth to die of this disease. Even if they take ordinarily good care of themselves, when middle life comes their heart, arteries or kidneys begin to wear out. This may be due to the poor material of which their vascular system is made, or to abnormally functioning organs, especially an insufficient liver. Whatever may be the particular weakness in their make-up, that weakness should be favoured. This can best be done, when we suspect an individual of being in this predestined class—and the suspicion is always excited by a family history of apoplexy, Bright's disease, diabetes, obesity, or chronic rheumatism—by giving him an anti-putrefactive diet, which is approximately, though not necessarily, completely lacto-vegetarian, and which is limited in quantity to his physiologic requirements; and by starting him on that diet as early as possible. And those who engage in the strenuous life differently from their ancestors and unhygienically, can with advantage make the work which their food puts on their already strained cardiovascular system as light as possible by such dietetic prophylaxis."

In concluding this chapter, I would like to emphasize the following points:—

The causes and prevention of arteriosclerosis have been considered in the past, as shown by the quotations, as matters of great obscurity and often placed on the shoulders of Providence.

I would like to emphasize the analogy between the universally recognized idiosyncrasy of some individuals to particular proteins that produce in them symptoms of pain, and the unconscious idiosyncrasy of many others to proteins which produce damage without conscious symptoms.

I would like to urge the importance of periodic examina-

[1] *Medical Record.*

tions of supposedly healthy individuals past forty, to detect and correct the conditions that might lead to arteriosclerosis.

I would like to again express my belief that the abuse of saline laxatives and their disturbing influence on the chemistry of the body tend to the production of arteriosclerosis, leaving castor oil now, as ever, the safest and best remedy for those threatened with chronic food poisoning.

Lastly, those with a tendency to arteriosclerosis must receive courses of treatment at intervals, such as are so finely developed in some of the cure resorts of Europe, and which we are now adopting in America.

The chemistry of food proteins in the blood is not yet well known. As a practical clinician, I look to the laboratory men for light, but I would warn them that the study of healthy individuals and people in hospitals will not afford them the same opportunities as are offered by cardiovascular disease in the well-cared-for classes, while the causes are active. What I have offered is a working hypothesis to explain results which have been duplicated by the same regimen in the hands of others though explained differently.

While revising this chapter, I have had the pleasure at the New York Academy of Medicine of listening to and discussing a paper on "Protein Assimilation," by Donald V. Van Slycke, M.D., of the Rockefeller Institute. He has estimated the amino acids in the blood and tissue and proved several things of interest on this subject.

Sufferers from arteriosclerosis may go on for many years enjoying good health and do all things within reason when their personal dangers have been determined. Among those in this class of arteriosclerotics was Mr. B. M., who first came to me five years ago at the age of fifty-six, knowing that he was a sufferer from arteriosclerosis, and asking whether he could get married.

He was a short, stout man weighing 180 pounds, and he said that five years previous to this he had had what he was told, and which from his description was an attack of angina pectoris.

At that time he was put upon a regimen, and the pain

did not recur with the same degree of severity, but from time to time he had had slight attacks of pain.

He said that his father had died suddenly at the age of thirty-three; his mother died of an accident at seventy-two; one brother of sixty-five was well. The urine showed a few casts, but was otherwise normal. There was a soft systolic murmur over the aortic area; blood pressure when standing was 175 mm. Hg. There was some thickening of the radial artery, and his appetite was excessive.

He was advised that under proper supervision he might continue in good health and get married.

He has been faithful to the few-protein diet and out-of-door exercise, with moderation in stimulants, and has remained well ever since.

XVII

EAR SYMPTOMS IN ARTERIOSCLEROSIS

The ear symptoms of cardiovascular disease may be believed to be such when they have developed coincidently with circulatory disorder, and when they are not the manifestation of disease of the ear itself. The decision on this point must be the outcome of careful study on the part of the specialist in circulatory disease with the co-operation of the aurist, and the final criterion must be the result of therapeutic measures.

Dr. E. B. Dench, of New York, has written as his judgment of the matter that: So far as he has been able to recognize, in all cases where there were aural symptoms dependent upon arteriosclerosis, there has been some well-marked lesion, either of the middle ear or of the labyrinth, perhaps slight in character, which, together with arteriosclerosis, has given rise to other symptoms. He believes that cases where there is a slight lesion of either the middle ear or labyrinth, which would otherwise cause no symptoms, may, in the presence of an arteriosclerosis, give rise to very definite symptoms.

I am conscious of the fact that tinnitus aurium is a condition that is ever pressing on the attention of the aurist, and has always been one of the hardest symptoms to relieve. For that reason, if some other department of medicine is willing to assume the responsibility of a few of these persons, to that extent is otology relieved. Already a certain number of cases have been relegated to that depository of ignorance which is labelled "neuroses," and the symptoms have been decided to be of nervous origin and not dependent on structural defect in the ears. That a certain number are

due to circulatory disease seems to me to be suggested by the fact that audible murmurs are often heard in the circulatory system in cases of anæmia and relaxed blood vessels.

Dr. John S. Weaver, of Kansas City, says[1]: "Most of our patients, and a great many general practitioners, scarcely think of tinnitus except as a symptom of actual disease of the ear. It will be shown that it occurs as a warning symptom in some general diseases, particularly of the heart, blood vessels and brain, where, if the ear be involved at all, it is of minor importance."

Indeed, several observers have discussed the significance of murmurs that are heard by cerebral auscultation. In an elaborate article seventy years ago, Dr. S. S. Whitney[2] describes the murmurs heard on auscultation of the head, and since his time other observers have discussed this topic. That there are certain circulatory sounds that are a great annoyance to the person and that can also be heard by the physician, while not of frequent occurrence, still has occurred in the experience of nearly everyone. In such a case we would not blame the ears as the source of the sound. It is reasonable to suppose that some of the sounds heard by the person alone are similar in origin, and it has been my good fortune in a few instances in which these sounds were believed by me to be due to circulatory disease to observe the removal of the symptom when the circulatory condition was improved. While I have seen this both in high and low tension, the most striking have been in instances of low tension. To quote from Wood's "Reference Handbook of the Medical Sciences":—

"Subjective ear noises are said by Politzer to occur in two-thirds of all ear cases, and are probably due in true ear cases to pressure and irritation of the nerve endings in labyrinth. Ear noises are variously described as singing, ringing, blowing off steam, hissing, rushing, roaring like the waves of the seashore, certain musical notes, clicking or voices.

[1] "Head Noises or Tinnitus Aurium." Published *Journal of Missouri State Medical Association*, August 1912.

[2] *Am. Journ. Med. Sc.*, 1843.

In some cases the noises are heard only during perfect silence, as after retiring or when the patient is fatigued or during a 'cold,' or when his general condition is below par."

Dr. S. MacCuen Smith, of Philadelphia, places kidney disease as a contributory factor in otitis media purulenta chronica.[1]

"Noises are more common in the sclerotic form of chronic middle ear catarrh than in the chronic suppurative conditions. In the sclerotic cases the tinnitus is frequently described as a singing or a blowing sound, and here it often precedes the deafness by many years, if indeed the latter ever follows. Tinnitus may occur in cases of aspergillus or of impacted cerumen, or it may follow the use of quinine or the salicylates. When it is due to drugs, it is evanescent and probably caused by anæmia of the labyrinth. If the noises are diminished by compression of the carotid artery, they are probably caused by congestion of the arteries of the middle or external ear, and in such cases they are often synchronous with the pulse.

"The clicking or crackling forms of noises are generally due to spasm of the tensor tympani or the stapedius muscles. In a certain number of cases these noises may be heard by the examiner as well as by the patient. When the subjective sounds are sustained musical notes, they usually represent the high A of Beethoven. Hysterical patients may describe the subjective musical sounds as 'entire operas.' Voices are rarely heard except in insanity. A small epithelial scale attached to the drum membrane has at times been the sole cause of distressing subjective noises. When the tinnitus intermits, the prognosis is more favourable than when it is constant."

It would seem to me that each case should be analysed according to the relations of three classes of causes. Naming these in the order suggested by my own point of view, I would say: First, an increase in the noise of the circulation just as there is an increase in the noise of a railroad by loose

[1] "The Ætiological Factors of Otitis Media Purulenta Chronica," *New York Med. Journ.*, 28th October 1911.

rails or flat wheels. Second, an increased sensibility of the auditory nerve apparatus, whereby the physiologic noise of the circulation becomes the subject of a conscious appreciation. Third, disease of the ear itself outside of the nerve apparatus, stimulating this nerve and inciting its characteristic impression, just as a blow on the eye produces the sensation of light. The situation is complicated because we must analyse these three elements, and in many cases all three are active; but from this it is fair to suppose that when we influence one of them and there is an improvement in the symptoms that we have controlled a part of the trouble. There is no fact that I have heard more often in my dealings with otologists than that tinnitus aurium is dependent in its severity on the patient's general condition, and there is no fact more certain than that the circulation is dependent on the general condition.

Dr. H. H. Martin, of Savannah, Georgia, writes for this chapter:—

"Personally I believe that arteriosclerosis belongs to that type of degeneration in which new material derived from the blood is deposited in the midst of the elements of a tissue, causing the absorption of the latter and their replacement by the former. I believe arteriosclerosis to be a condition brought about as the result of a general toxæmia caused by a poison or a group of poisons of which we at present know very little."

Great advance has been made of late years in the appreciation of the circulatory problem of disease. For many years high pressure cases were studied. Now low pressure cases are becoming better understood. I would also place among the most important advances in my knowledge of recent times the appreciation of the fact that weak circulation so often met with in severe disease is more often a matter of vasomotor deficiency than of heart weakness. The heart is usually competent to carry on the circulation provided the condition of the peripheral vessels can be properly controlled.

There are three great important locations of vasomotor

control: in the medulla and brain, in the spinal cord and in the blood vessels themselves. The first to fail in severe disease is that in the medulla, and recently it has seemed to me that I have studied cases of pneumonia in which the vasomotor control has been transferred from the medulla to the other two locations. In the low tension of the type in which circulatory ear symptoms were manifest, there seemed to me to be a combination of rather general vasomotor insufficiency, and degeneration of the heart muscle—in other words, a weak heart in which compensatory constriction of the peripheral vessels had not taken place.

Dr. W. K. Rogers, of Columbus, Ohio, has observed a relationship between arteriosclerosis and ear disease.

In this connection, I should like to call attention to a paper by Dr. John J. Kyle, of Indianapolis, on "A Study of Ear Symptoms in Arteriosclerosis, with Special Reference to the Labyrinth."[1] He refers to progressive loss of bone conduction, which he believes to be coincident with the development of arteriosclerosis. The article is so good that I should like to quote it in full in this connection, but it is a little aside from my own central idea, which has special reference to blood-pressure cases. He says in part:—

"The ear symptoms which should direct our attention to a local or general circulatory disturbance are unilateral or bilateral tinnitus, slight and progressive deafness, loss of air and bone conduction, dizziness, sometimes early in the disease and in the later stages of the disease, sometimes hallucinations of hearing. The ear symptoms necessarily vary according to the extent of the sclerosis. It is well known that in severe hæmorrhage and progressive anæmia, deafness and tinnitus may occur. If the hæmorrhage and anæmia are severe and prolonged, deafness may be permanent, being due to an obliteration of some of the blood vessels of the cochlea or the special cochlear centre in the brain. A passive tinnitus or dizziness is probably due to a circulatory disturbance in the arteries of the semicircular canal or special centres of equilibrium. These

[1] *Ann. of Otol., Rhinol. and Laryngol.*, June 1907.

conditions are frequently attributed to liver disorder, rather than a valuable symptom of a possibly beginning general arteriosclerosis. A deafness without dizziness, tinnitus or Menière's syndrome (providing no mechanical cause of deafness exists), with some general symptoms of arteriosclerosis, is indicative of thickening in vessels to the nucleus, and if associated with peripheral paralysis, may be indicative of disease of the internal capsule. Loss of hearing with dizziness may be due to a vascular disorder from tumours in the cerebrum, cerebellum or pons varolii, as well as to a sclerosis of the labyrinthine artery. Loss of hearing and dizziness, continuing for a long time, are valuable signs of vascular disturbance in the entire encephalon. If the eye symptoms are also present, the evidence is complete."

He also remarks earlier in the paper, what I find to be true, that:—

"Otologic literature is singularly barren in regard to ear symptoms in arteriosclerosis. . . . I can accentuate an opinion quite freely expressed and believed, that many ear symptoms, too often considered as purely local, are the local expression of a general disease. Therefore, a tinnitus and slight deafness, with slight loss of bone conduction, may be of far deeper significance than simply disease of the perceiving apparatus, and for this reason we should go deeply into the etiology of slight deafness, possibly blocking the march thereby of a general disease, which ultimately may harass, if not annihilate, the individual."

Dr. William Wesley Carter, of New York, tells me that he has seen a few cases of progressive deafness which were due to a general arterio-capillary fibrosis.

I find the literature on this subject is very scanty, and I attribute it to the fact that the critical study of the circulation as contrasted with the study of the heart alone has not been general up to the present time. The question of low arterial tension has been particularly neglected, and the tendency has been to omit from consideration the physiologic condition of the blood vessels, while paying undue attention to their structural state. The mistake has been

made of always attributing an over-abundance of blood in an organ to high blood pressure, while in fact relaxation of the blood vessels is a frequent cause. Murmurs are produced not by a constriction as such, but by a relative constriction, and a relative constriction can be brought about by dilatation, which causes the normal part of the vessel to act as a constriction. From this it is easy to understand why relaxed vessels produce a great deal of noise.

In a recent article, Dr. Alfred Stengel[1] says:—

"All of these symptoms will be recognized as occurring in the group of conditions caused by compression of the carotid arteries and also among the manifestations of gross cerebral thrombosis. When one or the other occurs, as a more or less isolated symptom in a case of arteriosclerosis, one hesitates to regard it as due to this cause alone, and very properly inclines to think it a part of some more definite focal, cerebral or visceral condition not yet fully developed. In many instances further symptoms may occur, and a cardiac, gastric, aural or focal cerebral cause may be recognized. Sometimes, however, such symptoms recur repeatedly, and no further developments take place until perhaps with increasing cerebral sclerosis more distant results follow."

Dr. W. Sohier Bryant, of New York, in an article on "Tinnitus Aurium" says: "Bilateral equal tinnitus indicates a constitutional cause, while bilateral unequal tinnitus located in the two ears indicates a local cause." Tinnitus with defective hearing may naturally be concluded to come from the ear itself. Circulatory tinnitus is frequently synchronous with the pulsation of the heart, but not always so."

Dr. G. W. Boot, of Evanston, Ill., says:—

"In my work I see arteriosclerosis chiefly in connection with the labyrinthine form of deafness, and whenever I find a case of labyrinthine deafness without obvious cause, such as trauma, epidemic cerebro-spinal meningitis, etc., I at once think of arteriosclerosis, and almost invariably find an increase in blood pressure."

[1] "Vertigo, Temporary Aphasia, Ocular Disturbance and Tinnitus with Cerebral Arteriosclerosis," *Am. Journ. Med. Sciences*, February 1908.

There is no class of individuals subject to more supposed local disease than those who suffer from a constitution of low arterial tension. This is a condition which I first described in 1904, and which refers to a certain type of circulation. To quote a brief description from my own little book on "Heart Disease and Blood Pressure." [1]

"It will be found that there are many patients who give evidence, on the most casual examination of the circulation, that the tension in the arteries is very slight, and in some this will be found a constant condition. It is surprising how little tension there can be in the radial pulse without the patient suffering from any symptoms of circulatory disease.

"This low arterial tension in otherwise apparently healthy individuals is undoubtedly a departure from normal. It may be due to an unusual relaxation of the peripheral circulation, which makes it possible for the heart to do its work with but little effort. Some of these patients are generally feeble, lacking in nerve force and unequal to strains. Others, however, seem to respond to demands for physical or nervous effort, and when so responding there is an improvement in the tone of the circulation."

When seen for the first time during some acute affection, this condition may give rise to apprehension on the part of the physician as to the outcome of the illness for which he has been summoned. When, however, the patient can be watched from year to year, and is seen to get along perfectly well, even though there is this lack of tone in the circulation, the physician comes to realize that with that individual it is a physiologic condition.

There is another form of low blood pressure that is much more dangerous, and that is the relatively low blood pressure which succeeds the high arterial tension of chronic Bright's disease. Here we have to deal with a most serious complication of the disease. It means that the circulation is no longer maintained by the heart. Thus, it may be stated that low arterial tension may exist in certain conditions

[1] Funk & Wagnalls Co., New York and London.

without great significance, but that if it has been preceded by high arterial tension it is a factor of grave import. With this condition we have nothing to do in the present discussion, but rather with low arterial tension that is a reflex of a constitutional condition.

Experience has shown that nothing is gained with these individuals by the use of drugs to increase arterial tension. It is quite possible to make the pulse for the time being approximate the normal; indeed, this often happens spontaneously when the heart and circulation are physiologically stimulated by exercise or fever.

The condition is, in all probability, due to an inherent defect in the nervous system, whereby it does not exercise the proper control over the blood vessels. The same patients who suffer from low arterial tension are very apt to manifest other symptoms of defective nervous control, and the removal of the underlying condition will bring about an improvement in the circulation.

The most important element of treatment is systematic exercise. These patients are often dependent for their well-being on regular physical exertion. Often they feel much better if they can take a brisk horseback ride every day, or some other form of stirring exercise. There are others in whom it is found that iron and arsenic improve the condition when it becomes very marked. In still others very hot baths take the place of vigorous exercise, and improve the tone of the circulation. It should be remarked that this is a secondary effect, because, if the circulation be examined immediately after the bath, it will be found to be more relaxed than usual.

Although one would expect beneficial results from cold bathing, it is found by experience to be unsatisfactory in cases of constitutional low arterial tension. Such subjects do not react, and the effect is not satisfactory.

These observations refer to a class of patients who are not suffering from any definite disease, but who realize that they are not the same as other people. They have probably been told that they are suffering from a variety of diseases,

according as the phenomena were supposedly traced to one or the other organs. To them may be applied the rather trite remark, that they are suffering from a condition rather than a disease, and such patients are fortunate if they come under the care of a practitioner who will appreciate this fact. The worst thing that can happen is that there should be repeated efforts to cure supposed disease by different men succeeding one another.

In this class of cases I have found ear symptoms consisting of a sense of fulness with slight tinnitus at times, which has cleared up entirely under the regular régime. A typical case of acquired low arterial tension was as follows:—

Mrs. E. B., aged fifty, consulted me five years ago, complaining of the following symptoms; She had been in good health until about a year previous, when she commenced to run down, feeling unable to undertake much physical exercise, losing her breath on exertion and, as she expressed it, "did not digest her food well." For three or four months before this examination she had had a puffing sound in her ears, which she described as synchronous with the pulse.

My clinical diagnosis from the physical examination and laboratory findings, coupled with the history, was myocarditis with relaxed peripheral blood vessels.

This woman's symptoms were relieved by sodium iodide and digitalis, with attention to diet, graduated exercise and hydrotherapy. Her condition was so improved that under supervision she has gone on ever since with only an occasional return of her symptoms.

Dr. Seymour Oppenheimer, of New York, says: "I have seen many cases of ear disease in which the cardiovascular factor had to be considered."

In conclusion, the author is led to believe that:—

(1) There are certain cases of tinnitus aurium which are a local manifestation of general circulatory disorder.

(2) This may have its foundation in structural changes but the blood vessel disorder is often, in a large measure, functional.

(3) It is found in connection with high blood pressure, and also with low blood pressure, and while in both instances the symptom is relieved by measures which regulate the circulation, the most striking results of treatment are to be obtained at the present time in instances of low arterial tension.

(4) A few persons who were decidedly deaf were improved, when there was present a well-marked chronic food poisoning, when they submitted to a few-protein diet and a very strict regimen.

XVIII

POINTS IN ARTERIAL DISEASE FOR THE SPECIALIST

From the facts set forth in this book, it will be concluded that arteriosclerosis is a general disorder, involving the cells of the whole body, and not a localized disease. For this reason, a complete diagnosis is as much dependent upon the history as upon the physical examination. Each worker will devise his own systematic plan of conducting the examination, and it is well to make a sharp distinction between the primary examination and the examination of return visits.

The first examination of a person with whom the physician is not acquainted must include many points to which it will not be necessary to refer later in the treatment, but notes of which must always be at hand for reference to throw light on future events as they happen.

I use a blank that is prepared for me by the Systematized Records Co., of New York. There is a first page which is used for the name, date, telephone number, age, occupation and symptoms. On this page I enter the person's description of his trouble, and I do this quite fully before I ask any questions. I demand a fairly specific statement as to what are the chief points of complaint. This entry is important, because it comes before the complete investigation, during which the questions often act by suggestion and alter the person's own point of view.

Picking a set of records at random from my filing case, I find in this space recorded on the sheet, "feeling of nervousness," "heart-beats in ears," "globus hystericus," "waves of heat," "palpitation," "cannot eat," "blurring of consciousness." 'On the reverse of this page is a space

for family history and a space marked "previous history," under which are the following items that are to be underscored according to their applicability to the history. It is to be remembered that these refer to habitual conditions, rather than those that may exist at the moment. For instance, weight is entered as "habitual weight," and a note made as to whether weight has been gained or lost. Beneath this is a space, which I use to enter what diseases have been present in the past. A transcript of the items is as follows:—

"Short, Tall, Med. ..... ft. ..... in. Stout, Thin. Wght., ... lbs. Blonde, Brunette, Indeterminate. Blue, Blue Brown, Black. Slightly, Very Neurotic. Mentality—High, Med., Low. Sleeps Well, Poorly. Appetite—Good, Poor. Vomiting—Eructs, Fulness, Discom., Immediate ..... hrs. After, Before, Eating. Bowels—Habit, Occas. Constip., Loose, Reg., Flatulent. Urine—Not Free, Painful; Amt., Increase, Dimin. Menses—Pain, Slight, Not Severe, Reg., Free, Scant. Tobacco—Hab., Occas., Mod., Excess. Coffee, Tea, Hab.; Both; Occas., Mod., Excess. Pulse Rate—Not Reg. Tension—High, Low. Arteries —Hard, Soft. Costal Abdom.—Expans., Good, Poor."

Having finished the entry on these two pages, I use my own daily blank to complete the examination. A facsimile of this is kept, and in explanation of abbreviations in the order of their use, they stand for:—

(Ad.) Address, (Tel.) Telephone Number, (Phys.) Physician, (Frnd.) Name of Nearest Friend, (Rel.) Name of Relative, (Age) Age, (Symptms.) Symptoms, (Bwls.) Bowels, (Slp.) Sleep, (App.) Appetite, (Hdche.) Headache, (Btng.) Breathing, (Plpn.) Palpitation, (Cgh.) Cough, (Pain) Pain, (Pulse) Pulse, (Cp. Cr.) Capillary Circulation, (B.P.) Blood Pressure, (D.B.P.) Diastolic Blood Pressure, (Hglbn.) Hæmoglobin, (Œdm.) Œdema, (Wt.) Weight, (Xrse.) Exercise, (Ndrnc.) Endurance, (Urn.) Urine, (Lvr.) Liver, (Lngs.) Lungs, (Is Taking) (Taki) Take, (Is Eating) Is Eating, (Ptn.) Protein, (Clrs.) Calories, (Al.) Alcohol, (Tob.) Tobacco, (Cff.) Coffee, (Avoid) Avoid, (Eat) Eat, (Mns.) Menstruation, (Plgrp.) Polygraph, (Psc. F.) Psychic Condition and Facies, (Apt.) Appointment, (Frds.) Friends, (Wn. Rds. Ald.) Own Remedies Allowed, (M.D.) Medicine Dispensed, (Xry) X-ray, (Und.) Undressed, and (C.O.) Castor Oil.

On the blank is a diagram of the heart, according to the

plan of Ewart, in which the cardinal murmurs are indicated to be crossed out if not present, thus making a permanent record of the fact that they have been looked for. In using this blank, the space underneath the diagram is used for the drawing of an additional diagram if necessary, or a line is drawn from any item in the body of the blank, after the manner of the correction of a printer's proof, and additional matter written in. The use of this blank, or one devised to suit the taste of the individual practitioner, renders the care of people with cardiovascular disease much more interesting and precise.

The hæmoglobin can be estimated in a few seconds by the Tallquist method, and the weight only takes a few moments more. These are two items of great importance, because the strict dietary of a cure of arteriosclerosis would be the source of endless anxiety to the physician, not to speak of the person under treatment, if this positive evidence of weight and blood could not be constantly observed to prove the bodily condition was not deteriorating.

A constant use of the MacKenzie, or some suitable, polygraph, is almost essential to the intelligent observation of arterial disorders. The absolute relationship between the heart and the blood vessels, as already referred to, in the light of development makes the study of the one without the other a medical absurdity.

A sufferer from arteriosclerosis should be under consecutive medical supervision. This does not mean that he need be running to his physician all the time, but after the preliminary treatment to put him in order he should return for examination once a month. The preliminary treatment, on the average, takes about two months, entailing at first daily supervision, and at the last a visit about once in two weeks.

There is always a very trying period in a typical untreated example of arteriosclerosis that might be called the detoxicating period. The person misses the stimulating effect of his accustomed protein poisoning in an extraordinary degree. There is often a period of gastric disturbance and

increased headache, while toxins are being dislodged and are being circulated in the blood. This condition is shown chemically by a great increase in the customary indicanuria. When physicans come under my care, I always tell them about this, and it is rather interesting to see their incredulity at my adventuring such a prediction, followed by their surprised acknowledgment after it has happened. While we do not know the exact relationships of indicanuria, there are many interesting points connected with it, not the least of which is this one.

Every physician in the world, I suppose, has had it said to him many times, "Why do not physicians adopt the Chinese custom of being paid when people are well and not paid when they are ill?" Whether any such thing really exists in China or not, I do not know. The point is that people believe that it does, and have vague ideas that some such arrangement would be advantageous.

In arteriosclerosis, it can be explained that the reverse condition is in a measure automatic. When persons return for examination once a month and are advised as to regimen and hygiene, they go on for years with little expense for treatment; but if they allow themselves to undergo a deterioration involving attacks of dilatation of the heart with the attendant conditions, it entails expensive nursing, much medical care and loss of time.

In the care of the disorder to which this book is devoted, it must ever be a drawback that it is a disease without symptoms. All of its symptoms are due to complications. It is worth while to spend a good deal of time and energy in convincing those who are the victims of the disease that they cannot themselves estimate the progress of their disease. Often enough, a sense of well-being means an increased arterial tension and is fraught with danger.

The most striking instances of this are those in whom the disease has its origin in chronic meat poisoning. When their physician has carried them nearly through the period of detoxication, some kind friend or complacent physician says to them, "A little meat will do you good," and return

to their meat sends their blood pressure up fifteen or twenty points, and they feel perfectly well. I remember one such instance of a man who came to me with a blood pressure of 220 mm. Hg, severe angina, profound depression and shortness of breath. After weeks of hard work, I had him in a condition where he could walk with comfort. The blood pressure had established itself at his irreducible minimum of 190 mm. Hg, and everything looked as favourable as could be. He was advised that a little meat would overcome his depression. He came to see me to tell me how much better he felt under the care of his new and more complacent adviser. I found his blood pressure 220 mm. Hg again, and he looked and felt much better than I had ever seen before. With a sinking heart, I told him how foolish I thought he had been, and within a few days a severe attack of angina carried him off. Of course, such conditions are extremely critical, but it is surprising how long a comfortable and satisfactory existence may be continued when the irreducible minimum of blood pressure is carefully managed.

We owe a debt to life insurance for emphasizing the importance of arterial disorders. A man may have very indefinite ideas about his health, but when a low financial value is put upon it, he no longer has any doubt that there is something requiring attention. The first physician to whom he goes may try to reassure him, but when he returns to the Insurance Company and the low money value is again placed upon his life, he seeks a specialist and may be restored so that he can insure his life. Many wise persons obtain a thorough examination before submitting to the life insurance examination, knowing that any primary rejection makes it extremely difficult to get insurance, as the companies interchange the names of those who are rejected.

I once advised a gentleman that it was very doubtful if he could obtain insurance. He left my house and the same day he went to half a dozen important companies and applied in person for immediate insurance. One of the companies insured him, and when, later, the companies all compared notes, they found that the rest had all rejected him. The

man had his insurance. I do not vouch for the ethics of this procedure, but it is an illustration of the personal equation in all matters of this kind, and I honestly believe that the company will not lose anything, as he is following a careful regimen.

Electricity has not found favour in the treatment of arteriosclerosis with those who have had to deal with its more serious development. While the author cannot endorse the belief that the suppression of a single symptom is a cure for the whole disease, it is only fair to refer to the opinions of the conservative men whom time may show to be more right than appears at the present moment. In a paper[1] that I heard at the New York State Medical Society, Albany, 1912, Dr. Edward C. Titus, of New York, said:—

"I have reserved the discussion of electricity in the treatment of hypertension for the last part of this paper in order to speak more fully of this agent, which in my opinion is still far from being appreciated at its full value. I am aware that there is still a general prejudice based on a misunderstanding as to the mode of action and utility of the different electrical modalities. To many medical men the entire field of electricity is compassed in the use of the galvanic and faradic currents, as if there was nothing else in what has grown to be the modern science of electrotherapy.

"A proper electrical equipment is seldom to be found in the office of the average practitioner even at the present time, and it may justly be asked whether the men who are so prone to criticize this valuable agent have taken the trouble to investigate the physiological and therapeutic effects of the different currents and familiarized themselves sufficiently with the technique of modern apparatus to justify their scepticism. Yet it seems to me that the extensive literature during recent years on the value of electricity in various diseases is evidence that the profession is at last awakening to its possibilities; therefore it requires no apology

[1] "Modern Physical Treatment of Arterial Hypertension." Edward C. Titus, M.D., *New York State Journal*, July 1912.

on my part to emphasize the importance of the high frequency currents in the treatment of hypertension.

"As no doubt you are aware, there are several kinds of high frequency currents, but the one referred to here is the autocondensation of D'Arsonval. Briefly speaking, this current may be obtained from a high-speed static machine of sufficient capacity, a Ruhmkorff coil of proper construction, and the more modern transformer apparatus, in connection with a resonator.

"These instruments should be provided with a milliamperemeter of reliable make, and the patient should rest on an autocondensation couch properly adjusted to the capacity of the machine—a current ranging from 5 to 8 hundred milliamperes is usually employed for from twelve to twenty minutes at each sitting. The applications are at first made daily until a considerable reduction in the blood pressure, as shown by the sphygmomanometer, is obtained, then on alternate days or at sufficient intervals to maintain the effect. Now as to the *modus operandi* of this method, I can best illustrate this by taking an average case.

"A patient of middle age presents himself with a blood pressure of 225 mm. in association with beginning arteriosclerosis. After an application his pressure is found to be reduced from 10 to 40 mm., the skin is moist and bathed in profuse warm perspiration, while the body temperature is increased from ½ to 2½°. Coincidently there is a feeling of restfulness and relaxation and relief of discomfort due to the hypertension. What does this signify?

"Now let us see how this is accomplished. Not one, but a number of factors are concerned in bringing this about.

"In the first place, the action of the high frequency currents employed in this manner is to dilate the peripheral vessels by relaxing vascular spasm. This will act beneficially by relieving engorgement of the internal organs, as evidenced by profuse diaphoresis and diuresis with increase of solids in the urine.

"In the second place, the current exerts a direct influence upon the cellular elements, which may be expressed

as a thermic effect. This manifests itself by an increase of oxidation processes, in consequence of which the elimination of toxic materials is augmented.

"In the third place, cellular metabolism is promoted, as is shown by the improved nutrition and the gain in physical and mental strength.

"One point of great importance in connection with this method is that it is unaccompanied by any depressing action upon the heart or respiration. This is strikingly shown by the fact that after D'Arsonvalization the pulse becomes softer and more regular, and there is an absence of any evidence of faintness or cardiac distress. It is therefore justifiable to assume that the effect is exerted upon the musculature of the arteries and not directly upon the heart.

"As has already been suggested, D'Arsonvalization does not depend for its efficiency upon its influence on the vascular apparatus alone. Thus, for instance, in cases of marked arteriosclerosis in advanced life where it is impossible to affect the lumen of the vessels, the patient nevertheless experiences a change for the better, probably as a result of the influence of the current upon metabolism, and in promoting elimination of toxins which play so important a part in this condition.

"But far more strongly than any theoretical deductions that I may be able to present, the results of clinical observation of many cases testify to the value of this method.

"Let me urge you to give it a trial in those cases where other measures have proved more or less disappointing, and then note the difference.

"You will find that when diet, drugs and exercise but moderately or temporarily affect hypertension, the addition to the treatment of the autocondensation high frequency currents of D'Arsonval will often produce a further reduction, or, at any rate, maintain the arterial pressure at a safe point with only infrequent applications.

"There are but two provisos that I desire to make: One is, familiarize yourself with the method before resorting to its use; the other, do not attempt to reduce hypertension in cases in which it is a compensatory phenomenon."

Dr. Titus' last two paragraphs only need emphasis to complete what is necessary to say concerning electricity. With proper diet and hygiene, electricity is hardly necessary as a form of treatment, though it may very well be a valuable adjunct.

No one should use electricity in hypertension without the counsel of someone capable of judging whether the condition is compensatory or not. A serious attack of decompensation, such as follows the injudicious use of high frequency currents, is too dangerous to life to be thought of as a justifiable experiment. I have seen at least one person in whom I believe death was hastened in this way, and a good many who were certainly set back by the experiment.

The hygienic treatment is so pre-eminently important that we must beware else any symptomatic treatment may lead us to neglect the constant reiteration that is necessary to hold the sufferer from arteriosclerosis in his narrow path to health. It seems certain that a measure that has so definite a physiologic effect on the human body and such manifest power over the circulation must have some proper therapeutic application.

All remedies of power are useless in one situation, beneficial in another, and harmful in a third. The usefulness or uselessness can only be determined by those who are familiar with the natural history of the condition under those forms of treatment that are used at the same time with the remedy under investigation. The harmfulness in improper cases is more difficult to prove, but it has become a matter of belief in the minds of experienced observers and is acknowledged by the electrotherapeutists when they speak of compensatory pressure. The over-enthusiasm of the special therapeutist is no new medical experience, and it is only through this that new measures are finally introduced. After a time—maybe a few years or generations—the special therapeutic measure passes from the hands of those who exploit it to become one of the treatments that is prescribed by physicians.

This is what will eventually happen to electricity. After a time, it will be prescribed by physicians according to the needs of the patient, just as we now prescribe baths or

massage. There is something incompatible in the long-run with the best interests of patients in the prescription and sale of a remedy by the same person. A separation of these two factors will take place, and this will be the solution of the proper application of electricity to arteriosclerosis.

All that needs to be added is that no good authority has stated that electricity in any form is a *specific* remedy in arteriosclerosis.

A man does not go very far in the practice of any branch of medicine without finding that mental conditions bear an important part in it. Cardiovascular disease is no exception, and various types of neurasthenia are a frequent complication.

Neurasthenia varies much in type with age. The youngest verge towards the type of acute simple anæmia, while the older ones approach the type of chronic diffuse nephritis. This may not have impressed others, but unconsciously I have found myself differentiating these various diseases in the younger and in the older group. Then there is the neuralgic type, usually differentiated from real neuralgia by the mobility and typical location of the pain. Those suffering from the nervous type complain most prominently of a general sensation of nervousness often described as "inward chill." The tendency in all forms is to exaggerate symptoms, and one who is not on the lookout is often enough deceived. These people come with a tale of constant abject misery lasting for a month at a time, of sleeplessness and absence of appetite, but, if you happen to observe them when going about their ordinary occupations, they show no evidence whatever of real symptoms.

One of the most unexpected and often one of the most confusing complications of arteriosclerosis is pericarditis. This sometimes gives symptoms which are very misleading, as, for instance, a marked to-and-fro murmur, such as might, if found under other conditions, be of intracardiac origin. It may give rise to pain that may be mistaken for the pain of angina, to which those with arteriosclerosis are very liable. It is often an afebrile condition; and, on the whole, it is more frequently discovered after death than recognized before.

It is always a surprise to us when we have followed a person for a long time with a non-inflammatory disease, that some time or other a true inflammation sets in as a sequence of debilitating conditions. Sometimes this leads to very puzzling problems in diagnosis.

An old gentleman may suffer for a long period of time with recurrent attacks of cardiac pain bearing all the characteristics of angina pectoris, and then sometime he will develop a painful condition of the chest that subsequent evidence proves to be a true serous inflammation of the pericardium.

A medical consultant or a new medical adviser would hardly fail to interpret the presence of a pericarditis, but the man who continues in attendance can easily for a time overlook a new cause for a slight modification of old symptoms. I remember being very much humiliated once, when I was conducting the practical part of a competitive examination in medicine for a salaried appointment, to have one of the applicants point out to me a serous inflammation in one of the inmates of my medical ward, with whose chronic ailment I was perfectly familiar. It had developed in the interval of my observations.

XIX

NURSING IN ARTERIOSCLEROSIS

As all that has gone before is very plain to the writer but may not be so to every reader, it is better to summarize the matter of diet by saying that the person who needs care on account of threatened hardening of the arteries should avoid all those foods which may contain, not *a* poison, but *his* poison.

The fewer protein foods that are used, the better the chance of doing this. The damage from poison is not in proportion to its amount, for even a little, continuously taken, may keep trouble going on. The diet must be very strict. What is one man's meat may be another man's poison. All general rules in this matter are foolish. Every person's diet must in the long-run be determined after intelligent observation.

In dealing with proteins, the same problem is found as in many other relations in life. If we exclude all servants from our houses, we will certainly not have a bad servant to deal with. If we use no alcohol, we need not distinguish between good and bad wines. But servants add much to our comfort, and a little wine adds to the pleasure of many occasions. Protein food is not only desirable for our comfort and pleasure, but necessary to energize us, if we are to do constructive work in the world.

In this chapter, in a more homely way, an attempt is made to review some of the problems arising in the care of those who are afflicted with arteriosclerosis, so that it may be easily understood by persons who seek information because they must attend to the nursing of those who have acquired this disease.

Arteriosclerosis is the name of a condition closely resembling the wearing out of the body by very old age, but which is found when the number of years to which every living human being is entitled has not been enjoyed. It is caused by the gradual damage of the active machinery of the body by poison and by the conditions set up by poisons.

This poison may be of several kinds: it may be the poison of some infectious disease; it may be a metallic poison like lead; or, as happens much more often, it is derived from the food, because the person who is to be afflicted by the disease has lost the power to deal successfully with certain poison groups that result even from the natural chemical action of the body in the use of animal protein food. This does not mean that these proteins, which are found usually in most instances somewhere in meat, fish, eggs and stock soups, are poisonous to everyone, but only to persons who become sensitive to them.

The intestinal tract and the liver are the organs that most need attention, but the relation of the blood and fixed cells of the body to the unfriendly split products is important.

Arteriosclerosis is a disease that has no symptoms and until lately was supposed to have no successful treatment. It should be treated before symptoms appear, because when they come it is on account of the development of complications.

The disease becomes "mitralized" when one of the valves of the heart becomes stretched from weakness. Before this the muscle of the heart may be poisoned by the same poison that is causing the other damage, and show weakness, or give pain or a tight feeling in the chest.

It is very important that anyone who is responsible for nursing should have an intelligent knowledge of the pulse and some of the ordinary remedies. The subject is too complicated to put in a few words, but brevity has been observed as far as possible.

The pulse occupies a good deal of the attention of physicians and nurses, but it does not always occupy as much of the real thought as it ought.

The pulse is the general name given to the wave motion

that is imparted to the blood current by some movement on the part of the heart, and, surprising as it may seem, also by movements on the part of the blood vessels. If a stone is thrown into a lake, a wave which can be seen with the eye is started that spreads in every direction on the surface of the water; or if in the dark the hand were thrust into the water, one could feel the wave as it passed. That is like the pulse—a wave of motion. The pulse is not caused by the passage of blood, just as the wave of the lake is not caused by the passage of water. It is the passage of an impulse from one part of a body of blood to another part. In other words, it is a form of motion and not a material thing.

That is well illustrated by taking the end of a piece of string attached to something at the other end, and if the string is shaken, the wave which the motion generates at one end of the string passes to the other, but the string itself does not move from place to place. It is in just the same place as before the wave passed along it.

The pulse is a wave motion in the blood, and has nothing to do with the flow of the blood itself, so the pulse is not the measure of the amount of blood that is flowing. It is the measure of the amount of wave motion that is imparted to the blood by the contractions of the heart.

Another proof of this is that the artery can be compressed completely at the wrist so that the blood cannot flow through it, and yet the pulse can be felt just above where it is compressed, although, of course, there is no blood flowing through the vessel.

Up to quite recent times, when we spoke of the pulse it was understood that we referred to the pulse that is felt at the wrist—in the radial artery, and we considered that as the principal pulse in the body, though it might be felt at the radial artery, the temple, or at one of the arteries of the leg. In other words, the arterial pulse was the only pulse we considered.

Of late years, those who have paid most attention to circulatory disease have come to regard the pulse in the

veins as of great importance. It is, indeed, of great value and has reference to the contractions of the auricle. The heart is divided into four chambers, two auricles and four ventricles. The four chambers of the heart come pretty closely together, so that in a picture it is not easy to separate them visibly. The blood enters the auricle, which is separated from the ventricles by valves, and then it enters the ventricle and is pumped into the arteries (we are speaking of the left side of the heart). The contraction of the ventricle causes the pulse in the arteries. The contraction of the right auricle in health causes a pulsation in the veins called the jugular pulse, because it is generally observed in the jugular vein.

The jugular pulse is of a good deal of importance provided we observe it. Those with experience in sick persons with heart disease and in some other very sick people, can see a very marked pulsation in the neck. That is often the jugular pulse, and has a particular significance. It means ordinarily that the auricle is not working properly, and that is a serious matter to the heart.

I have been at great pains to explain the nature of the pulse—that it is a wave motion and not the motion of the blood itself. The blood, of course, is flowing toward the heart through the veins, and yet the venous pulse travels from the heart up the veins. This is very puzzling if one thinks about it. There is a great beating in the veins but the blood is flowing in a different direction. If a stone is tossed into the water, the wave from the stone travels upstream against the current. In the same way, the venous pulse travels upward from the auricle into the veins.

I have recently had printed some nurses' charts for my private practice, and I put at the top of the chart that the nurse should observe any pulsation at the neck, because in very sick people the onset of pulsations in the neck means weakness of the auricle, and the auricle is the part of the heart which has to do with the origin of the contractions and of the heart's regularity. It is like the sparking part of an automobile—if this gets out of order the engine sputters and

does all manner of things; and it is the same way with the heart when the auricle misbehaves.

The most irregular hearts we have to deal with in very sick people are hearts in which the auricle is paralysed—that is, where there is a trembling palsy of the auricle. These are the cases in which there is this marked pulsation in the neck. This is a common complication in arteriosclerosis.

In health, the blood flows into the auricle; then the auricle gives a little contraction and drives the blood into the ventricle, then the ventricle contracts and drives it onward. Also, in health the jugular pulse comes a little before the radial pulse, so that you find the pulse in the veins a little before the pulse at the wrist, because the auricle contracts and drives the blood into the ventricle, and the ventricle contracts and drives it into the arteries.

This is the natural way, but this little healthy contraction of the auricle does not make a pulse that is big enough to be noticed. If we look very, very closely in a good light at the neck, sometimes the natural wave or auricular contraction in the jugular vein can be seen, but ordinarily it is too slight to be noticed; we can only get it by careful measurements with apparatus. So the natural jugular pulse is not observable by ordinary means.

In serious cases of arteriosclerosis, the auricle may become paralysed and dilated, and then poisoned and does not work at all. In these instances, the contraction of the heart sends a wave back into the veins, which is the visible pulsation in the veins that we are so familiar with in very sick heart patients. Now that wave, of course, really has its origin in the ventricle. In other words, it sends a wave back through the paralysed auricle into the veins, and in that case our tracing from the veins is very much like our tracing from the wrist. In other words, we get what is known as the ventricular form of venous pulse. This may seem a little complicated, but it is the latest advance in the understanding of heart disease. It involves more than half of the very sick people of this kind. It is a thing that can be easily suspected by a very simple symptom—by this pulsation

in the neck. It is one of the great discoveries of modern times, so I do not hesitate to warn the nurse to look for its symptom. When the nurse puts her hand on the pulse of a very sick person, and can see a pulse in the veins, which corresponds to the pulse at the wrist, particularly when the heart is irregular and rapid, she has every reason to suspect that there is paralysis of the auricle.

There is a very nice thing about this form of heart disease: It yields to digitalis in a very specific manner. Digitalis often comes as near to bringing about the resurrection of one practically dead as any drug that I know. It restores the circulation, removes the dropsy and gives back a heart that is useful and able to carry on the circulation.

The Chinese are said to be a people whose practice of medicine is founded almost entirely upon the pulse. The sick one in China sometimes goes to the physician and thrusts his hand through a curtain, and the physician feels his pulse, makes a dignosis and prescribes. In the Chinese books of medicine, there are said to be hundreds of different kinds of pulses described. It is very foolish to say that any great nation is entirely wrong in anything that is a large part of one of their arts. However, we cannot help believing that the Chinese are a little one-sided in paying so much attention to the pulse, but they have undoubtedly been able through thousands of years of observation to put into writing a whole lot about the pulse which we have not.

The pulse, in a great measure, is to be estimated as a matter of judgment. The nurse feels the pulse, and says, "The pulse is better to-day than it was yesterday." Now what does she mean? She means that she thinks it represents a better condition of affairs, but this may be far from true. A weak pulse is not exactly a bad pulse: a strong pulse is not necessarily a good one. Everything depends upon the circumstances. It is better to be guided by certain rules that we can formulate than it is to be guided by our impressions.

I do not want to try to imitate the Chinese and describe

five hundred different kinds of pulses, for I probably could not do it.

In the first place, the nurse should not be misled by an apparent weakness of the pulse or encouraged by an apparently strong pulse. A weak pulse in a person generally feeble, who is lying low, without any demands on the circulation, may be a conservative pulse for that person, because it does not use up any energy and gives him a chance to recover. So a weak pulse that is not rapid in a feeble person is not alarming and not to be treated as such. The thing to be considered when the pulse is weak is not whether the pulse can be made stronger, because the pulse is only a wave motion transmitted from the heart, but whether the blood is circulating properly; this is determined by the fact of the effect on the essential organs of the body.

When I am teaching students, I repeat, over and over again, the signs of circulatory failure. These are: Shortness of breath on account of the deficiency of the blood supply to the lungs, swelling and tenderness over the liver because the blood is not pumped out of the liver, and dropsy. Therefore, if a man can lie down in bed and breathes quietly, is not tender over the liver, and there is no dropsy, ninety-nine times out of a hundred that man is not in any danger from circulatory failure, and there is nothing to worry about because the heart is not sending big waves along the blood vessels to make a pulse.

On the other hand, a man may have a pulse which is very hard and bounding, which seems to be very strong—easy to feel and see and count—but he may be short of breath, have congestion of the liver and dropsy, and is in danger of circulatory failure, and needs attention.

Observers often make the mistake of applying stimulation to weak persons to make the pulse stronger to feel, and it is a very unwise thing. It is not done so much in medical work as in surgery. The foolish stimulation of a person does harm and really wears out the heart and disturbs the circulation, making the chances of getting a real circulatory failure greater.

As long as a man breathes well, has no congestion and the blood is circulating properly, there need be no anxiety about the character of the pulse.

There is one sign of circulatory failure that is of more importance than any other, and which one should always watch, and that is, an increase in the rapidity of the pulse. By examining the charts of any one of fifty persons who have died with exhausting diseases or acute diseases, we find that the failure of the heart was often characterized by an increase in rapidity. So, if the pulse averages 80 one day, 82 the next, 84 the next, 90–100–110–115–120–130–140–150–160—if the heart is becoming progressively rapid —that is always a very serious matter and should receive the utmost attention.

In considering this increase in rapidity we should always discount the presence of fever, because the two things that make the heart rapid usually are fever or weakness of the heart; so if there is no increase in fever and the heart becomes gradually more rapid, it is a serious sign.

In feeling a pulse the nurse should not be misled by the difference in pulses, that can be accounted for by the variation in the character of the vessels themselves. In young people the artery is soft, and in old people it is often hard. In young people the blood pressure is low, and in older people it is higher. It must ever be remembered that an old person may show signs of failure of the circulation and yet have a strong pulse; a young person may have no signs of failure of circulation with a weak pulse.

To those who are not physicians and who take up this book to increase their knowledge to help them in the nursing of the sick, whether professional nurses or not, I want to speak at length on the most wonderful of all circulatory remedies, but the most difficult to know and use. Digitalis was discovered by an Englishman, Withering by name, who administered it to those suffering from dropsy, with effects that were so marvellous that its fame soon spread throughout the world. It was adopted and never has been given up; and as far as I can see, there is no prospect that it will ever be super-

seded. It is one of the drugs that is fundamental to the practice of medicine.

Withering described a class in which digitalis acted specifically to bring about a cure, and these, he said, had very rapid and irregular hearts, swollen limbs, dropsy and shortness of breath. This condition has only been diagnosed correctly within the last four or five years, since we have known the true nature of fibrillation of the auricle. So, for a hundred years or so, people were treated with digitalis and cured without our knowing the true nature of the disease till just lately. It is a very interesting chapter in the history of medicine.

I believe, also, that it is only of late years that we have understood the real nature of digitalis and its true bearing on diseases of the heart.

During the last fifteen years a large number of observers have been devoting all their time to studying the heart, both its physiology and its behaviour in sick people. We now know pretty certainly that the heart-beat has very little to do with the nervous system, but is entirely independent of the nerves in its action. So an animal's heart entirely separated from the body, without any nerve control at all, may go on beating for several days providing there are suitable surroundings. That could not be if the heart-beat came from the nerves or the spinal cord, or even the nerves of the brain.

It has been a great puzzle to know how the heart can beat like a pulsating engine apparently without anything to make it beat, and by exclusion we are driven to the belief that the cause of the heart-beat is chemical. There is something going on in the heart all the time in the nature of a chemical action that generates a substance, and when that substance reaches a certain amount of development it explodes and the heart contracts and uses up the material. Then the material has to accumulate again, and when it accumulates to a sufficient degree the heart contracts again, and that goes on all the time—the constant formation of the material so that the heart can contract, the destruction of

the material by the heart-beat, and then its reaccumulation. It is very much like pouring water steadily into a balanced bucket—when it gets full it upsets, and then fills again and upsets again, and so on. That is the way we get a rhythmical action from a constantly acting cause.

Just as we have got away from the belief that the heart action is due to the control of the nervous system, so we have got away from the belief that digitalis acts chiefly through the nervous system. We find that while digitalis has an effect on the nervous system, its effect on the heart is a chemical one; that digitalis modifies the chemistry of the heart in such a way that it influences this material that makes the heart beat, so that the heart-beat is changed. This fact is important, because it has a very great bearing on the administration of digitalis.

The administration of digitalis is just as if there was something acid that it was desired to render alkaline. An alkaline liquid is dropped in and the mixture remains acid until enough has been dropped in; then at a certain moment the mixture becomes alkaline. In other words, there is a certain time when something takes place. Or it is just like when water is put over a fire to boil,—nothing happens until the water reaches a certain temperature, and then the water boils.

Digitalis modifies the chemistry of the heart, and in such a way that the chemistry changes. It is changed at the time when enough digitalis has been given: before that time there is very little change in the heart-beat. That has a very important practical bearing. Let us suppose a man in my ward has fibrillation of the auricle. He comes in with his heart very rapid and irregular and is given digitalis. The first day nothing happens, the second day nothing happens, the third day nothing happens, and perhaps the fourth day nothing happens. But about the fifth or sixth day, all of a sudden, his pulse is found to have dropped from 140 to 90, and he feels better and the dropsy is disappearing. Then the digitalis is stopped and resumed in very small doses—a reduction is made from a tablespoonful of the infusion every

four hours to one every night or every second night. In that way his heart remains at 90, he does very well, and his condition remains good. But if the digitalis is stopped the heart begins to get rapid again, and he is back to where he was before.

The reason for this is, that after having modified the chemistry of the heart by digitalis, it must be kept modified by adding as much digitalis to the heart every day as is lost by the natural elimination of the drug. If, when this man first came in, he had been given a tablespoonful every night, this could be continued for months and no great good would be done, because the elimination of the digitalis would be just as much as the intake.

The whole thing is very, very simple when once understood. It has been a great puzzle to doctors and nurses for a good many years. They would give digitalis and be absolutely disappointed because they did not get any effect. Then they would give digitalis and get a very striking effect. This I will explain more fully later.

So it should be remembered that digitalis must be administered first up to the point of saturation so as to modify the chemistry of the heart, and then enough to keep up the effect; in the same way, when water is once boiling, if put over a little fire it keeps boiling. If the heart is saturated with digitalis, and a little given right along to keep it saturated, the benefit continues.

There are some precautions that must always be borne in mind. In the first place, when a man is admitted to an hospital it is never certain what he has had outside. If he has had no digitalis he can be given in divided doses the eight to sixteen ounces of the infusion that it takes to produce saturation. The trouble is that such people have generally had digitalis, and it is not known how much they have had. For that reason we can never tell when the saturation will be completed.

The complete digitalis saturation is reached when the heart is continuously slowed. It is reached when the patient vomits, that is, when this vomiting can be traced directly

to the digitalis. In some patients it is reached when the drug produces diarrhœa. If any of these things happen—definite slowing of the pulse, vomiting or diarrhœa—the person is saturated with digitalis, and then the large doses should be stopped and small doses substituted to keep up the effect on the heart.

Digitalis stands for a great group of drugs of which strophanthus and squill are two other important members. There are others about which we hardly hear any more. I believe that nothing takes the place of the fresh infusion if it is good, because we get the effect of the whole drug, and I think it produces a better effect. Failing this, I think the next best thing is the tincture of digitalis, but this has to be given in larger quantities. In order to produce saturation, it is necessary to give a dram a day, 20 drops three times a day, and then after saturation is reached smaller doses are continued. To get saturation a teaspoonful a day of the tincture is administered, which is a large dose according to custom. One should always take into account the amount of digitalis the person has had before he comes under treatment, and then watch should be kept for the moment of saturation.

There is very little danger in saturating a patient with digitalis, providing he is digitalis-free. The danger lies in continuing it beyond the point of saturation and not stopping these huge doses when the saturation is complete. There is very little danger up to the point where the sufferer vomits. When he does vomit, digitalis is stopped, and then only enough given to make up for what is eliminated. Continued after saturation, digitalis is apt to do a great deal of harm.

Another very important point for nurses to know is that the vomiting of digitalis never comes on till saturation is reached. That is, a person with heart and kidney disease, no matter how sick he may be, does not become nauseated by the digitalis until he gets enough to saturate his system, that is, eight to ten ounces of the infusion. Let us not confuse the nausea of a bad heart or of kidney trouble or

of the stomach, and so on, with the vomiting of digitalis, because I see every year people with heart disease where the nurse and doctor protest against digitalis, fearing that the stomach is too weak to stand it. Then, when digitalis is given, the circulation is improved, the vomiting stops, and the man is better.

Last winter I saw a physician's mother, an old lady. The son declared that his mother could not take digitalis. She had a typical fibrillation of the auricle, a very rapid and irregular heart. When the digitalis was given in large doses, and the system saturated, she got better and was able to go out, and was altogether relieved of the symptoms from which she suffered. This happened despite the fact that she thought she could not take it on account of an upset stomach.

The vomiting of digitalis is exactly like sea-sickness. It occurs when the system is saturated. The man will vomit just as surely when the drug is given hypodermatically as when given by mouth. It is not nausea, but sea-sickness. Sea-sickness will happen when the stomach is empty. Sea-sickness comes from nervous irritation, because the balancing machinery of the ear is upset from the constant effort to balance the roll of the ship, but the stomach is where it is felt. It is the same way with digitalis. It is an essential nausea, and the effect of digitalis on the nerves of the stomach, but not on the stomach itself.

To reiterate, digitalis stands for a class of drugs, and it practically stands alone.

I do not often use anything else. I did use strophanthus and squill. It is practically proved, at least to my satisfaction, that there is no great difference between strophanthus and squill and digitalis, except that it is customary to give them in different doses. If we give strophanthus and squill we get the same effect. There is nothing gained in medicine by multiplying our tools.

As for the effect of digitalis in small doses in a person who has not been saturated, I believe there is a great deal of uncertainty. It is customary to give digitalis in small

doses, but where there is dilatation of the heart, first saturate the system. I know a great many heart patients are benefited by so doing. People may also improve when given small doses, but they do not improve in the same specific manner as when the drug is given to saturation. The administration of digitalis at such times is also often accompanied by nitrites and other drugs, so it is very hard to be sure of its individual effect. I think any person who really needs digitalis is entitled to saturation at the beginning. Then we know where we stand.

The effect of digitalis on the heart is to increase the tonicity of the heart muscle, and also it produces a slowing or even blocking of the impulse of the heart between the auricle and the ventricle. What is meant by tonicity is the continuous partial contraction of a muscle. By examination, anyone can feel a certain amount of tightness in the muscles of the legs. If that leg had become paralysed recently, it would be found that the muscles of the paralysed side were soft and flabby. There is a distinct difference in the feeling, and that is because the tonicity of the muscle is lost. In the same way, in dilatation the heart has lost its tonicity and is loose and flabby. Digitalis makes the muscle contract and become firmer; this gives the heart a better grip on the blood and enables it to do its work better. Then digitalis blocks or makes the transmission of an impulse through the heart slower, or even cuts it off entirely, so that it slows the heart, and the heart rendered slow does distinctly better work.

It has the same effect also in contracting the blood vessels, but in lesser degree.

The story of digitalis is like that of all knowledge: the more we know, the simpler it becomes.

These few facts should be remembered. First, that digitalis acts on the heart by modifying the heart-beat. Then in connection with the modification of the heart-beat, it is necessary to remember that the heart-beat is a matter of chemistry, and that there is something generated in the heart that makes it beat; the beat uses up that material,

and then the material regenerates and the heart uses it up again. That is the way we get a rhythmically acting heart from a continuously acting cause within the heart itself.

The beat of the heart has little to do with the nervous system. The nervous system can slow the heart-beat or make it fast when that is required in particular emergencies, but the heart can beat independently of the nervous system. The independence of the heart-beat can be proved any time by looking at a frog's heart after removing it.

Another point to bear in mind is that, in its effect on the heart, digitalis is dependent upon a sufficient dosage up to the point of saturation. Then there is a change in the heart which modifies its action in a profound manner. After it is once saturated, digitalis must be continued in a dosage just sufficient to replace the amount that is lost every day by elimination. There is a distinct difference between a person who is saturated and one who is not. It is just the same as getting water hot enough to boil. When the water begins to boil, it can be kept boiling for an indefinite length of time with a little heat.

The signs of saturation are the slowing of the heart, nausea or diarrhœa. The nausea of a very sick person is not due to digitalis unless he is saturated with the drug. Also, a person does not vomit with digitalis under two or three days unless he is already filled with it. The vomiting of digitalis is not from the nervous system, which affects the stomach.

For practical purposes there is no important difference between strophanthus, squill and digitalis except in customary dosage.

The effect of digitalis on the heart is not changed by time, as far as we know. Digitalis can be given for a great many years with a continuous effect, and this is a very wonderful thing. Dr. Groedel, of Nauheim, told me of a doctor he had had under his care for eleven years, and all that time the man took digitalis because he needed it. I have many patients who are absolutely dependent on digitalis, and who take it year in and year out. It is best in

people with severe heart trouble to saturate with digitalis, and then give small doses continuously, than it is to treat them and get them well, and then send them away to get sick again. In fibrillation of the auricle, people can be kept well over a long period by small doses of digitalis, while if neglected they are liable to attacks of dropsy, shortness of breath, and all the miseries that go with heart failure. I sent an appointment card to a man who is a theatrical manager to come and see me (I see him once a month), and his wife wrote me that he had gone to Atlantic City to try out a new play on the Broad Walk before bringing it to New York. This man was brought to me a year ago by a neighbouring doctor. He was dropsical and short of breath, and had every appearance of a man with advanced Bright's disease. He turned out to have arteriosclerosis complicated by fibrillation of the auricle. He was saturated with digitalis and put on a proper diet, and went back to work. He takes a tablespoonful of digitalis every night, and is able to get about and work, and even took a play to London a few months ago. He gets on very well, but is absolutely dependent on digitalis. It is certainly one of the most satisfactory remedies that we have to deal with, but one of the most puzzling if one lacks skill in its use.

In emergencies that occur to people with hardening of the arteries it is our own experience that more than half of the time the trouble is not as bad as it seems. Attacks of suffocation are perhaps the most alarming to those in attendance, and attacks of angina pectoris most terrifying to the sufferer. Both have a natural tendency to pass over,—the compensatory phenomena of the circulation becoming more and more active until the obstruction yields.

A knowledge of the natural history of these attacks makes it possible to meet them with a spirit of hopefulness that is entirely different from the panic that often seizes the members of the family and even the physician. Surprising as it is that recovery is possible from these attacks, it is equally wonderful that the treatment often applied is not fatal. Excessive drugging is dangerous. Fortunately, but

few drugs have a direct effect on the heart, and these act but slowly. Strychnine is almost universally used and never seems to do any harm. It undoubtedly revives the nervous system and puts it on guard. Caffeine is seldom used in doses that count very much, so these two drugs (caffeine and strychnine) can be considered safe; the same is true of camphor hypodermatically which has a reputation as a quick stimulant. Alcoholic stimulants and ether are valuable as quick means of reviving a collapsed person and are not harmful.

Where the greatest harm is done in meeting emergencies is by the injudicious use of morphine. I cannot subscribe to the belief that is common, that morphine is harmless in emergencies that occur in the course of arteriosclerosis. Whether the attacks of angina pectoris that have called for morphine have been worse I do not know, but I have a distinct impression that the fatalities of attacks so treated have been much more numerous than can be accounted for in this way.

Venesection is of great value as an emergency measure when the clinical picture suggests an over-distension of the right heart, and in very high pressure. The amount of blood that it is necessary to remove as a trial measure is not great. Eight ounces is enough, and that is very little when we think that the total volume of the blood in almost anyone exceeds eighteen pounds.

For attacks of pain (intermittent claudication), nitroglycerin will, of course, suggest itself immediately. Recently a young man suffering from well-marked aphasia that was believed to be due to claudication seemed to be benefited by a few doses of veratrine. A remedy that has the advantage of a household reputation to suggest in emergencies of arteriosclerosis, and which really does good, is sweet spirits of nitre (spiritus etheris nitrosi). Aconitine is also of value in disturbance of the circulation in arteriosclerosis as a temporary measure. I have been accustomed for many years to carry in my pocket-case a supply of the small red granules that are made by the Abbott Alkaloidal Company, and have

found that a few of these have often tided a person over a restless night after I had paid a late visit.

But the really great emergency drug in arteriosclerosis is nitroglycerin. I make it a practice to have all sufferers from this disease and all nurses supplied with a reliable granule containing $\frac{1}{225}$ of a grain, with instructions to use it in any emergency of pain, fainting or distress in breathing, and to repeat if necessary.

XX

THE CHEMISTRY OF THE PROTEINS

Proteins constitute the most important constituent of the human body, and are therefore the element of greatest consequence in nutrition.

The chemistry of protein has been under investigation for a very long time, but progress has been slow on account of the great difficulty of the subject. As clinicians we are not interested in the technical details of chemistry, but try to draw all we can from this field of knowledge that is applicable to the understanding and treatment of disease.

Bio-chemistry has devoted itself to a great extent to the problems of the digestion and assimilation of protein, and has not sufficiently studied as yet the relationships to disease.

Carl Voit,[1] after forty years of strenuous work in this field, could say no more than that "the unknown causes of metabolism are found in the cells of the organism. The mass of these cells and their power to decompose materials determine the metabolism."

"We have at present a more or less detailed knowledge of the preliminary processes which occur in the preparation of the food protein as a suitable pabulum for the tissues during gastrointestinal digestion. We know that the protein is practically completely disintegrated into very simple compounds before absorption and utilization takes place. We have also a fairly complete knowledge of the products excreted in the urine — the waste products of protein

[1] Introduction to E. P. Cathcart's "The Physiology of Protein Metabolism," 1912 (Longmans, Green & Co.).

metabolism—and we have been able to associate many of the variations of the metabolism, or, at least, alterations in the conditions affecting the organism, with variations in the output of these waste products. We know, for instance, that an animal fed on a food poor in protein excretes very much less nitrogen than one fed on a nitrogen-rich diet, and that there is a great diminution in the proportion of the nitrogen excreted as urea. We further know that creatine is never present, or only in minute amount, in normal urine, when the food taken contains no creatine, yet after a comparatively short period of fasting creatine is always to be found; and again we know that a high output of ammonia is closely associated with the production of acids in the tissues. Of the various steps, however, of the intermediate metabolism which lead to the formation and the excretion of the different products, we know but little.

"Faced with the question as to the nature of the processes which lead to the building up of the material commonly known as 'tissue protoplasm,' we are at the very outset hampered and confined in our quest for accurate information by the imperfect knowledge which exists as to the very nature of the material formed. Can we with right assume that such a substance actually exists as a constant chemical entity, a substance immutable in form, but variable in quantity? Does it wax and wane as does a crowd, the units constituting the whole, inconstant in number, but identical in nature, or is it a material unstable alike in form and amount? As Sir Michael Foster wrote in 1885: 'He (the biologist) may speak of protoplasm as a complex substance, but he must strive to realize that what he means by that is a complex whirl, an intricate dance, of which what he calls chemical composition, histological structure, and gross configuration are, so to speak, the figures; to him the renewal of protoplasm is but the continuance of the dance, its functions and actions, the transferences of figures.' Strive as we may, our insight into this intricate problem of the nature of living matter is faulty. We see though a glass darkly.

'Despite this scanty knowledge, questions of such primary importance arise that their solution must be attempted. Such a question is that of the real demand for protein by the body. Does the organism require a large intake of protein, or can it subsist on a relatively small one? We know by direct observation that under normal conditions the amount of nitrogen excreted is directly dependent on the amount of protein taken in the food, that is, if a definite amount of nitrogen in the form of protein be ingested, a similar amount of nitrogen, in the form of waste material, from which practically all the energy has been extracted, will appear in the urine. What has happened to the nitrogenous material which left the lumen of the intestine in the form of 'digest' products? Has it all been utilized for the necessary repair of tissue waste, or has part of the material absorbed been stored, and a corresponding amount of material present in the protoplasmic complex been excreted? Must this material taken up by the blood from the intestine be first converted into 'living protoplasm' before it can be available for use in the tissues, or can disruption of the absorbed molecule occur without this synthesis? It is now more or less generally accepted, irrespective of the mode of such decomposition, that soon after absorption the protein products are split into a nitrogen-containing and a nitrogen-free part. The use and value of the former portion is universally admitted, as nitrogen is an absolutely essential constituent of all living tissue, but does the non-nitrogenous rest play a special part in the metabolic processes which cannot be performed by non-nitrogenous material arising from the breakdown of either carbohydrates or fat? Does this non-nitrogenous part of the protein molecule simply serve as one of the sources of the energy supply, or does it, owing perhaps to a more highly specific nature, play an intimate part in the synthesis of fresh protein material?"

This quotation from the preface of one of the latest works on protein chemistry, shows that speculation still enters largely into the matter. From the point of view of a study of arteriosclerosis, these considerations need not trouble us,—

further than as they confirm our belief that specific proteins are capable of causing the condition.

Voit's remarks concerning the cells, quoted above, are in accord with our theory, that the real trouble lies in these ultimate cells.

Nature and the cupidity of man seem to provide a much greater number of proteins than necessary, or else man in his civilization has come to use more than was intended. The danger seems to lie in the multiplicity of these substances, and the possibility that particular ones may be harmful to any given individual.

One of the best things that the bio-chemists have given us, is the fact that this great complexity of proteins is not necessary to nutrition or human welfare, and they have proved that even a single protein may be enough.

The process of digestion is one of degradation, whereby the complex protein is broken up, later on to be recomposed to suit the needs of the animal. Under some circumstances there is a failure somewhere in the operation, and the cells come in contact with proteins to which they are sensitive.

Cathcart [1] says in reference to the fate of protein after absorption:—

"If the view be untenable that the protein enters the organism from the intestine in the form of proteoses and peptone, in what form does it enter? At present there is a very marked difference of opinion on the question. One set of workers claim that immediately after absorption the products of digestion are synthetized to a coagulable protein, whereas the other set maintain that the absorption takes place in the form of very simple protein products . . . either as simple amino acids or groups of these—and that it is in this form that protein is conveyed in the blood stream, allowing each tissue to choose for itself the food which it demands. As Leathes neatly puts it, 'the proteins circulating in the blood, are a currency which are not legal tender.'

[1] F. P. Cathcart's "The Philosophy of Protein Metabolism," 1912 (Longmans, Green & Co.).

"Abderhalden, among the modern workers, has been the most active in upholding the view that a synthesis takes place in the intestinal wall immediately after absorption, and that therefore all the material is sent into the animal organism in the form of coagulable protein. Abderhalden and his co-workers hold further that the protein which is formed is a neutral protein, probably serum protein.

"They depend for their evidence very largely on the fact that the decomposition products of the protein have not, in their opinion, been clearly demonstrated to be present in the blood. Abderhalden, however, admits that the present methods for the estimation of small amounts of amino acids are very unsatisfactory.

". . . In spite of all these difficulties, a certain amount of evidence does exist in support of the contention that the simple products of digestion are to be found in the blood, more particularly in the portal stream at the height of digestion."

Cathcart says further concerning the nature of the absorbed material:—

"Thus there is no direct evidence which definitely determines the form in which the digestion products of protein reach and travel in the blood. Wherein, it might be asked, lies the benefit of converting the protein into simple products like the amino acids to have them immediately after absorption takes place converted into a neutral protein? The complete breakdown in the gastro-intestinal tract probably takes place either because the highly complex molecule is not readily dealt with as such by the tissues or because certain amino acids, as for example glutamic acid in gliadin, which are present in excess in the molecule and which are not required for the building up of the tissue protein, must be eliminated.

"The view that the tissue proteins differ from one another, that they are specific bodies of definite constitution, and that therefore each requires a different amount and supply of building material, is gradually being accepted.

Abderhalden himself accepts this. What end, then, is served in having a single uniform pabulum formed when the demand is so varied?

"Further, the belief is gradually gaining ground, as regards the protein requirements of the organism, that it is not so much the actual quantity as the quality of the protein supplied in the food, which is of importance. If the material supplied be uniform it necessitates a fresh breakdown by each tissue, perhaps by each individual cell. Although the tissues all probably possess this power of breaking down protein material by means of their intracellular proteclytic enzymes, still the extra work involved seems to negative the immediate resynthesis hypothesis, especially when the hypothesis of the circulating digestion product postulates the presence of the individual food material in the blood. As already remarked, the mere failure to detect these products in the blood does not give adequate reason for concluding that they are not present. The tissues certainly do not break down in regular sequence, nor are they left to fall to pieces for lack of repair material. Repair is among the most active functions of all tissues. Must, then, a tissue of highly complex structure keep destroying and digesting plasma, picking out from the debris the nuclei which it requires and letting the rest go? (Why, and this destruction is admitted by Abderhalden, are the superfluous amino acids not found in the blood?) What happens, for instance, in the case of the connective tissues with their demand for, say, glicine, where the food supply is not over-abundant as the circulation is poor, and the tissue not very suited for lymph perfusion? It will not do merely to say that there is no great breakdown of material here.

". . . The balance of evidence seems to me to be in favour of the hypothesis that the synthesis of protein in the body is a function of each individual cell, and is not confined to one set of cells (those of the intestine). Further, that the material which is utilized in this synthesis is not circulating in the fluids which bathe the tissues as a "whole" or "neutral" protein but in the form of amino acids or groups

of these—the products of the hydrolytic decomposition of proteins.

". . . As regards the practical protein minimum for an everyday dietary there is great difference of opinion, more practically since the interesting work of Chittenden was published. Voit had laid it down as the result of repeated experiment and observation that the daily intake of protein should be about 120 grms. Chittenden[1] believes that this amount is much too abundant, and that any person who lives up to this standard and who encourages others to do so is encouraging individual and race suicide.

"He was able to maintain nitrogen equilibrium on diets which contained about 6 grms. of nitrogen, equivalent to some 40 grms. of protein, and which were in addition of very low caloric value, 27 to 28 calories per kilogram. Chittenden's investigations were not merely confined to experiments on himself, but were arranged on a large scale and carried out on three different classes of men: (1) professional men engaged for the most part in laboratory work, (2) on student athletes who were in training for various university contests, and (3) on soldiers who performed a series of regulated exercises daily. The period during which these men were under investigation was also a prolonged one, thus giving the experiment a good chance of failure. Chittenden maintained that the results were excellent both physically and mentally in all classes of individuals on an intake of protein on the average about half that of the so-called Voit standard.

"As a matter of fact, the intake of protein in the diet of the average individual, as evidenced at least by the output of nitrogen in the urine, is not so large as is commonly believed. It has become a habit to assert that the average intake of protein in the food of the average man is large, but this assertion is probably not true, particularly in the case of those who follow sedentary occupations. Thus Hamill and Schryver,[2] for example, examined the urine of seven indi-

[1] Chittenden, *Physiological Economy in Nutrition*, London, 1905.

[2] Hamill and Schryver, "Nitrogenous Metabolism in Normal Individuals," *Journ. Physiol.*, 1906, p. 34, "Proc." x.

viduals in the Physiological Laboratory of University College, London, who, during the period of examination, maintained their everyday existence, no care being exercised in the choice of food, and they found that the output of nitrogen corresponded to an intake of some 90 grms. of protein per diem. From my own experience this amount is probably a good average value."

The necessity for variety in food is emphasized by all experimenters, but it is evident from prolonged clinical observation that as a practical matter it is possible to exclude safely from the diet quite a number of proteins that are under suspicion as causes of arteriosclerosis without any practical or theoretical danger.

Besides the special proteins to which the cells are supposed to be sensitive and which by their prolonged irritation cause the generalized deposit of connective tissue most marked in the heart and blood vessels, there are also various poisons of intestinal origin which have a powerful effect upon the functions of these organs. These substances are closely allied to intestinal putrefaction. In the Middleton-Goldsmith Lecture [1] before the New York Pathological Society, in 1911, Dr. Frank P. Underhill dwelt upon this. I cannot do better than quote from this lecture:—

"Recent investigations concerning the structure of proteins have led to a readjustment of our ideas with respect to the manner in which these substances may become an integral part of the organism; and the study of the changes which occur from the time when protein has been built up into cell structure until its exit from the body in the form of waste products is at present only in its infancy. According to the newer conception, the protein molecule is a huge complex consisting of the union of a large number of simple amino acids. This conception is due largely to the researches of Emil Fischer, who has succeeded in fastening together various combinations of amino acids in such a manner that

[1] "A Consideration of some Chemical Transformations of Proteins and their Possible Bearing on Problems in Pathology," reprinted from *Arch. of Inter. Med.*, September 1911, vol. viii. pp. 356–381.

the resulting compound behaves in some respects like certain of the proteins. Some of these substances, called polypeptids, have indeed been isolated from the decomposition of native protein. According to Fischer, proteins are merely mixtures of complex polypeptids and cannot be considered as chemical individuals. This view, however, is not shared by other protein chemists.

"In its passage through the alimentary canal the large protein complex undergoes a degradation—a transformation into simpler molecules which are still regarded as simple proteins, together with a long chain of amino acids belonging to the aliphatic, aromatic and heterocyclic series. Our modern view of the nature of protein forbids the acceptance of the older idea that the necessity for alimentary treatment of protein is merely to transform protein into a condition suitable for absorption. Obviously, solubility and diffusibility are only a small portion of the process; otherwise it would be unnecessary to entail so much labour on the gastro-enteric tract by the apparently needless formation of amino acids. The need for nitrogenous substances is to replace cellular structures worn out through metabolic activities. Just how this replacement occurs is problematical. Certain it is that the only detectable nitrogenous food supply for such structures is to be found in the proteins of the blood. No amino acids or other protein decomposition products have been isolated from the blood.[1] An explanation for the necessity for the extensive disintegration of the protein molecule has been offered as follows:—

"Every species of animal—in fact, every individual—has its specifically constituted tissues and cells. If the diet were always the same, the formation of the tissues might bear some close relation to the components of the food. The diet varies, however, and, especially in the case of human beings and the omnivora, is exceedingly diverse in nature, and to make its organism independent of the outer world in the

[1] Morawitz and Dietschy, *Arch. f. Exper. Path. u. Pharmakol.*, Leipzig, 1905, Bd. liv. S. 88. Abderhalden and Oppenheimer, *Ztschr. f. physiol. Chem.*, Stuttgart, 1904, Bd. xlii. S. 155.

matter of food taken, it disintegrates the nutrient it receives, and utilizes those components which may be of service to it in building up new complexes.[1]

"Many important functions have been attributed to the intestinal wall, but perhaps none of more significance than a selective power for the synthesis of amino acids into serum albumins. According to this view, the intestine receives a series of more or less simple amino acids, and by uniting them in varying proportions forms definite compounds, probably serum proteins, to meet the organism's requirements. The serum proteins are then drawn on to furnish nitrogen requirements for the specific organ or group of cells. This probably entails a further transformation. Such a theory accounts for the necessity of the complete degradation of protein in the gastro-enteric canal, and accords with the entire absence of cleavage products in the blood. On the other hand, this extensive degradation, synthesis and further disintegration appears quite uneconomical physiologically. In the first place, only a comparatively small amount of nitrogen is needed to rebuild tissue, and the excess must be transformed into some form easy of elimination, all of which entails loss of energy and tissue waste. It is a matter of common observation that when protein is fed, practically all the nitrogen is rapidly excreted, and one is inclined strongly to believe that this portion has never been resynthesized into protein. If amino acids or other decomposition products could be found in the blood, the solution of the problem would be at hand. The failure to discover them does not disprove their presence, however, since the quantity in the portal vein, at any one moment, may be so small as to escape detection with our present methods.

"Whichever way one views this problem, the fact remains that sooner or later intermediary processes must be concerned, primarily with a series of amino acids. These are the substances that must be metabolized in either case, and it is to some of the transformations that these compounds may

[1] Abderhalden, "Text-Book of Physiological Chemistry," trans. by Hall, 1908.

undergo within the organism that I particularly desire to call attention. It is my purpose to indicate the probable bearing of certain types of intermediary processes upon problems in pathology, for it is my belief that the hope for a better understanding of some of the phases of disease will be realized in proportion as our knowledge of some of the intermediary processes increases.

". . . *Bacterial Products: Indol, Skatol, etc.*—As a result of the bacterial digestion of protein, certain well-known and well-defined products have been isolated and their specific influence on the organism noted. Not only have these bodies been separated and identified, but the chemical transformations leading to their formation have been made clear. The protein derivatives, tyrosin and tryptophan, are the mother substances for the best known bacterial products. In the intestinal contents have been found a number of substances which are undoubtedly derived from tyrosin. These compounds are:—

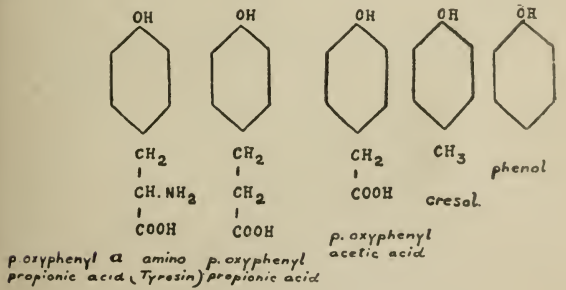

FIG. 16.—The constitution of tyrosin.

"According to these reactions, a deamination of the aromatic amino acid must occur in the large intestine. The further reaction for the production of p.-oxyphenyl acetic acid involves the cleavage of carbon dioxide from the carboxylic group and subsequent oxidation of the carbon atom. If phenol is produced from cresol, then demethylation must

occur. These reactions, if correct, must involve the processes of deamination, cleavage of carbon dioxide, oxidation and demethylation. From tryptophan the following products are formed:—

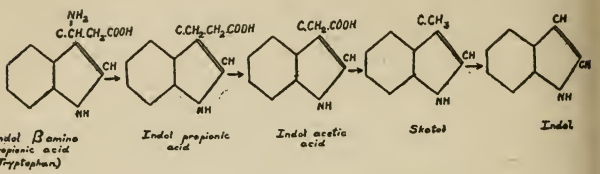

Fig. 17.—The constitution of indol and skatol.

"From these reactions it is obvious that the same chemical changes have occurred as in the transformations for tyrosin, namely, deamination, carbon dioxide cleavage, oxidation and finally demethylation. On the other hand, it has been suggested recently that indol may arise in part as a result of intermediary processes quite distinct from those involved in putrefaction.[1]

"Ordinarily, when intestinal putrefaction is mentioned one invariably thinks of indol and skatol as being responsible for the series of disturbances which may be associated with this condition. It has been assumed that a long list of pathological conditions may be closely related to increased intestinal putrefaction. Thus, this condition has been held responsible in part for sciatica, tetany, epilepsy, eclampsia, many forms of dermatitis, cirrhosis, arteriosclerosis, various types of nervous diseases, chlorosis, myxœdema, cretinism, pernicious anæmia and nephritis.[2]

"Although there is abundant clinical evidence that excessive intestinal putrefaction may be associated with, or responsible for, marked disturbances, the substances thus far isolated from intestinal contents cannot be said to possess very profound toxicity. It is true that indol when ad-

[1] Blumenthal, *Biochem. Ztschr.*, 1910, Bd. xxix. S. 472.

[2] Weintraud, *Ergeb. d. allg. Path.*, 1897, Bd. iv. S. 17. Myers and Fischer, *Centrabl. f. d. ges. Physiol. u. Path. d. Stoffwechs*, 1908, new series, Bd. iii. S. 849.

ministered in quantities up to 2 gm. per day causes frontal headache, irritability, insomnia and confusion,[1] and it has been shown further that indol and skatol cause muscle to react to stimuli like fatigued muscles.[2] But the comparatively slight toxicity can hardly be responsible for some of the symptoms observed. Various explanations have been offered to account for the discrepancy noted between clinical evidence of intestinal intoxication and the fact that the substances formed thus far isolated are only slightly toxic. The most plausible explanation for the discrepancy mentioned is that the list of compounds which may be formed in putrefaction has not yet been exhausted, and it is possible, and indeed probable, that in time other compounds of putrefactive origin will be found that will adequately account for the clinical symptons observed. On the other hand, it is possible that indol and skatol may exert quite different effects on the normal organism from those which it exerts on a body whose resistant powers have been lowered as a result of other pathological processes. In other words, the receptive condition of the body under the two conditions mentioned may be entirely different, producing in turn quite radically differing symptoms.

"*Amines and their Formation.*[3]—That we have by no means isolated all the active principles from putrefactive mixtures may be well illustrated by the investigations recorded during the last three years. In 1907 Dixon and Taylor [4] aroused considerable interest by the publication of their observation that alcoholic extracts of the human placenta when injected intravenously caused a marked rise in blood pressure and contractions of the pregnant uterus. On repetition of this work, Rosenheim [5] failed to corroborate the findings of Dixon and Taylor when extracts of perfectly fresh placenta were employed. When, however, extracts of

[1] Herter, *New York Med. Journ.*, 1898, vol. lxiii. p. 89.
[2] Lee, *Journ. A.M.A.*, 1906, vol. lxvi. p. 1499.
[3] Barger and Dale, *Journ. Physiol.*, Cambridge, 1910, vol. xli. p. 19.
[4] Dixon and Taylor, *Brit. Med. Journ.*, London, 1907, vol. ii. p. 1150.
[5] Rosenheim : *Journ. Physiol.*, London, 1909, vol. xxxviii. p. 343.

placentas in various stages of putrefaction were intravenously administered, results were obtained identical with those of Dixon and Taylor. A substance responsible for these effects has been separated and identified by Barger and Walpole,[1] according to whom the active principle is p.-oxyphenylethylamin, and may be derived from tyrosin as a result of the following reaction :—

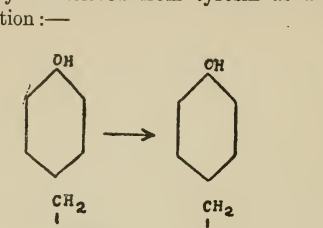

FIG. 18.—Origin of p.-oxyphenylethylamin.

" Moreover, iso-amylamin has been isolated from putrefactive mixtures probably derived from leucin in accordance with the following reaction :—

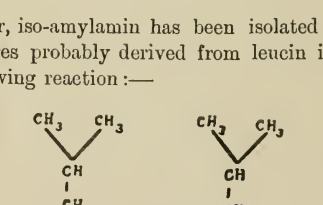

FIG. 19.—Origin of iso-amylamin.

" These results have led the authors to remark that they are induced ' to emphasize the probability that the amines

[1] Barger and Walpole, *Journ. Physiol.*, London, 1909, vol. xxxviii. p. 343.

which we have isolated are normally formed by putrefaction in the intestine and are absorbed from it.'[1]

"The compound, p.-oxyphenylethylamin, is of peculiar interest for several reasons. In the first place, it was originally isolated by Emerson[2] from an autolysis of pancreas, and its mode of formation from tyrosin has always been considered unique. It is obvious at present that it was probably produced by putrefaction in this case also. Much more interest attaches to this substance from its great resemblance, both structurally and pharmacologically, to epinephrin.

"'P.-oxyphenylethylamin has an action very similar to

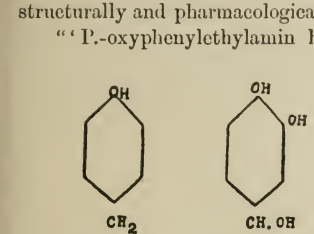

FIG. 20.—Relations of p.-oxyphenylethylamin to adrenalin.

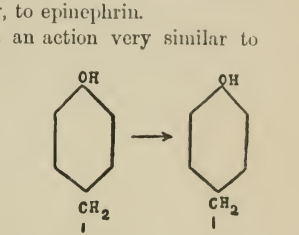

FIG. 21.—Relations of p.-oxyphenylethylamin to p.-oxyphenyl acetic acid.

that of adrenalin (epinephrin), reproducing both the motor and inhibitory effects of nerves of the true sympathetic system. It produces the motor more powerfully than the inhibitory effects. Its action differs from that of adrenalin in being weaker and slower in onset, and in being less strictly though mainly peripheral. It is absorbed from the subcutaneous tissues and the alimentary canal, and produces its effects when so administered.'[3] Isoamylamin has a similar action.

"Finally, it is of exceeding great interest to note that p.-oxyphenylethylamin is one of the substances which give

[1] Barger and Walpole, *Journ. Physiol.*, London, 1909, vol. xxxviii. p. 343.

[2] Emerson, *Beitr. z. Chem. Phys. u. Path.* (Hofmeister), 1902, Bd. i. p. 501.

[3] Dale and Dixon, *Journ. Physiol.*, London, 1909, vol. xxxix. p. 25.

to ergot[1] its characteristic action on the uterus." It is also probable that it is identical with the urohypertension of Abelous and Bardier.[2] These observations also indicate the necessity for controlling all possible sources of bacterial contamination when extracts of animal tissues are employed in demonstration of specific action. Again, "Many observations have been published recently concerning the presence in the blood-serum and urine, in various pathological conditions, of substances which cause dilatation of the pupil of the enucleated eye of the frog. The fact that both these amines have this action casts some doubt at least on the validity of the assumption made by certain observers, that the substance in serum responsible for this effect is adrenalin.[3]

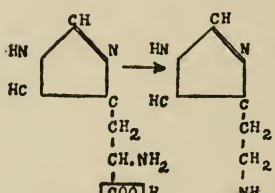

FIG. 22.—Beta-iminazolylethylamin.

On introduction into the body the base is eliminated as p.-oxyphenyl acetic acid,[4] another example of deamination.

"When histidin is subjected to the action of putrefactive bacteria, a compound[5] is produced which holds promise of being responsible in a measure for certain reactions which have long been unexplained.

"This substance, beta-iminazolylethylamin, resembles in some respects p.-oxyphenylethylamin in that both compounds are contained in ergot extracts, and both substances exert

[1] Barger and Dale, *Arch. f. exper. Path. u. Pharmakol.*, Leipzig, 1908, Bd. lvii. S. 366.

[2] Abelous and Bardier, *Journ. de Physiol.*, Paris, 1909, tome xi. p. 34.

[3] Dale and Dixon, *Journ. Physiol.*, London, 1909, vol. xxxix. p. 25.

[4] Ewins and Laidlaw, *ibid.*, London, 1910, vol. xli. p. 78.

[5] Ackermann, *Ztschr. f. physiol. Chem.*, Strassburg, 1910, Bd. lxv. S. 504.

similar influences on the muscle of the uterus. In addition to the reactions possessed in common with p.-oxyphenylethylamin, beta-iminazolylethylamin is capable of calling forth symptoms practically identical with those induced by injections of peptone solutions, or by serum or other protein in the sensitized guinea-pig, that is, producing anaphylactic shock.[1] The base has also a mild, direct, stimulant effect on the activity of the salivary glands and the pancreas. This secretory action, being paralyzed by atropin, may be regarded as a weak action of the pilocarpin type; the association has some interest, in that pilocarpin also contains an iminazole ring. More recently this base[2] has been isolated from extracts of the intestines, thus lending support to the suggestion that under normal conditions it may exert a more or less definite function in the maintenance of nutritional rhythm.

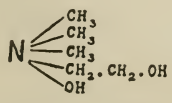

FIG. 23.—Cholin.

"Closely associated with p.-oxyphenylethylamin in extracts of placentas is another compound which may also be considered as an amine and which has an action antagonistic to that of p.-oxyphenylethylamin. This compound, cholin, has been the subject of a great deal of discussion during the last few years.

"It undoubtedly has its origin in a lipoid compound, lecithin, a constituent of practically all cells. It is therefore apparent that in putrefactive processes in the tissues, cholin may arise in relatively large quantity and, although not highly toxic when given by mouth, it may be exceedingly poisonous when allowed to come in contact with nervous tissue. Thus, Donath[3] observed severe tonic and clonic convulsions after cholin had been injected directly into the cortex or under the dura. This investigator offers the

[1] Dale and Dixon, *Journ. Physiol.*, London, 1909, vol. xxxix. p. 25.
[2] Dale and Laidlaw, *ibid.*, 1910, vol. xli. p. 318.
[3] Dunlop, *ibid.*, 1896, vol. xx. p. 82.

opinion that cholin may be responsible for epileptic convulsions—an opinion founded on the fact that he with other investigators[1] has been able to demonstrate the presence of cholin in large quantities in the cerebrospinal fluid of epileptics and in other conditions associated with destruction of nervous tissue. In accordance with this idea, unsuccessful attempts[2] have been made to demonstrate the presence in the blood of cholin in animals during the tetanic convulsions caused by complete removal of thyroids and parathyroids. The removal of the glands has been shown to result in marked changes in certain areas of the nervous system,[3] and it was assumed that these histological changes were due to chemical reactions whereby cholin might be liberated and produce a secondary effect.

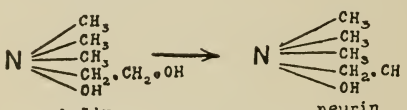

FIG. 24.—Cholin and Neurin.

"Chemically related to cholin is neurin, a substance easily formed from cholin by oxidation, which is nearly twenty times as toxic as the latter. The possibility presents itself that neurin may be formed from cholin within the organism under certain pathological conditions and may be responsible for some of the symptoms characteristic of certain abnormal conditions as salivation, vomiting, diarrhœa, and a specific action in causing arrest of respiration. This formation of neurin within the organism, and any relationship which it may bear to deranged metabolism, has never been conclusively demonstrated. It has been shown, however, that neurin may be excreted, at times at least, through the urine.[4]

[1] Halliburton, *Ergebnisse der Physiologie*, 1904, Bd. iv. S. 23. Rosenheim, *Journ. Physiol.*, London, 1906–7, vol. xxxv. p. 465.

[2] Underhill and Saiki, *Journ. Biol. Chem.*, 1908, vol. v. p. 225.

[3] Vassale and Donaggio, *Arch. ital. de Biol.*, Turin, 1896, tomo xxvii. p. 129.

[4] Kutscher and Lohmann, *Ztschr. f. physiol. Chem.*, Strassburg, 1906, Bd. xlviii. S. 1.

"These compounds, together with muscarin and betain, constitute one of the groups of the ptomaines, so called, and hence heretofore have been interesting chiefly because of their advent into the organism through the introduction of decomposing tissue taken as a food. Nevertheless, inasmuch as they arise outside the body as a result of putrefactive process, there remains open the possibility that they may be formed in the alimentary canal or in tissues either in a process of degeneration or putrefaction. The old idea that there is a hard-and-fast line to be drawn between plant alkaloids and animal poisons is rapidly disappearing, and the fact that one toxic compound, as for instance muscarin, occurs as a rule in plant tissue, does not exclude the possibility of the presence of the same body as a result of chemical reactions within the animal organism. The best recognition of this disappearing demarcation line is to be found in the new publication by Winterstein and Trier,[1] where all basic substances, whether of animal or plant origin, are considered as alkaloids.

"From this review of the more recently discovered compounds which may arise within the body by putrefactive processes, one fact stands forth with striking clearness, namely, the possible functions which some of these substances may exert in physiological processes and their significance in problems concerned with disease. We have seen that one compound resembles epinephrin, both structurally and in physiological activity, while another simulates the activity called forth by pilocarpin. Epinephrin and pilocarpin are in daily use as drugs, the degree of whose activities may be regulated at will. The protein derivatives mentioned have practically similar actions, but, as they arise within the organism, cannot be subjected to voluntary control. It is likely that under normal conditions only small quantities of these compounds may be thrown into the blood stream, and that there is some nice adjustment of mechanism which may have an influence on the further beneficial disposition of these bodies. It is conceivable,

[1] Winterstein and Trier, *Die Alkaloide*, Berlin, 1910.

however, that at times an undue quantity of such material may overwhelm the regulating mechanism to such a degree that substances which perhaps normally aid in the maintenance of physiological rhythm may indeed become responsible for the advent of normal reactions. The suggestion is therefore offered that some of the disturbances associated with excessive intestinal putrefaction may have such an origin. A hypothesis of this sort readily furnishes an explanation for the vaguely defined headache and general malaise characteristic of the previously mentioned pathological states.

". . . APORRHEGMAS: In a recent communication, Ackermann and Kutscher[1] have proposed a new designation for the transformation products of amino-acids which are formed by life processes whether in the animal or the vegetable kingdom. The term employed for these bodies is 'aporrhegma.' It is interesting to note the number of such compounds which may arise from putrefaction alone. The above-mentioned authors,[2,3] have given a list of these substances, together with the amino acids from which they are derived.

AMINO ACID.	APORRHEGMA.
Histidin	Iminazolylethylamin. Iminazolpropionic acid.
Arginin	Ornithin. Tetramethylendiamin. Aminovalerianic acid.
Lysin	Pentamethylendiamin.
Glutaminic acid	Aminobutyric acid.
Asparaginic acid	Alanin. Succinic acid.
Glycocoll	Methylamin.
Leucin	Isoamylamin. Isovalerianic acid.
Prolin	Pyrrolidin.
Phenylalanin	Phenylethylamin. Phenylacetic acid. Phenylpropionic acid.

[1] Ackermann and Kutscher, *Ztschr. f. physiol. Chem.*, Strassburg, 1910, Bd. lxx. S. 365.

[2] Ackermann and Kutscher, *ibid.*, 1910, Bd. lxx. S. 365.

[3] Ackermann, *ibid.*, 1910, Bd. lxx. S. 273.

Amino Acid.	Aporrhegma.
Tyrosin	Oxyphenylethylamin. Oxyphenylacetic acid. Oxyphenylpropionic acid.
Tryptophan	Indol. Skatol. Indolpropionic acid. Indolacetic acid.

"The modern conception of the living cell makes enzymes responsible for the numerous types of known activities; thus we speak of enzymes facilitating reduction, oxidation, deamination, cleavage, etc. One organ is found to contain enzymes active to a high degree in one direction, another organ in another direction, and still a third organ which may furnish an almost unlimited number of enzymes capable of performing varied types of reactions. Ordinarily when enzymes are mentioned, one thinks involuntarily of the best-known agents, the digestive ferments. Our ideas concerning the exact mode of action of these enzymes that undoubtedly play an important rôle in intermediary metabolism are not well defined. It is probably, however, not an unwarranted position to assume that the several types of reactions discussed in previous portions of this paper have enzyme activity as their basis.

"With the acceptance of enzyme activity as the foundation of cellular chemical activity, hence, intermediary processes, it is easy to conceive how the induction of abnormal environment for these agents may lead to the production of distinctly pathological phases of metabolism with consequent injury to the whole physiological economy. In our endeavour to discover the reason, or the cause, for abnormal metabolism, we have been led into the error of looking for changes of too great magnitude. Enzymes are exceedingly sensitive to all sorts of changes in environmental conditions. Too much acid, or too little, lack of the requisite inorganic salts, perhaps absence of carbohydrate—that group of substances vaguely designated as co-enzymes—may retard or hold in abeyance certain types of reaction the effects of which, over a considerable period of time, work injury to other types of

enzymes until finally a large number of processes may be carried out only imperfectly.[1] Perhaps one of the best examples of the point under discussion may be taken from the recent work of Bywaters,[2] who found that the inverting power of an aqueous extract of yeast is increased by ten- to fifteen-fold by the addition of acetic acid. On the other hand, this activity given by acid addition is susceptible of removal by alkalies, which subsequent addition of acid is capable of counteracting. Under one form of environment the power disappears, and when changed to another the power is restored.

"With data of this type at hand, is one unwarranted in suggesting the probability that pathological metabolism of various types may be the direct result of changed environmental conditions of intracellular enzymes? I believe that such a viewpoint will do much toward a solution of many problems concerning metabolism both from the standpoint of physiology and pathology, the dividing line of which is exceedingly narrow.

"The advances of the future are to be made, I believe, by a careful study of small changes, details which at first thought perhaps appear insignificant but if followed will lead to far-reaching results.

. . . . . .

"If the view suggested is correct, then the hope of future advances along the line of intermediary metabolism lies in an appreciation of the significance of small differences and changes in the environmental conditions of the cells."

Those wishing to pursue this subject farther must go to chemical literature rather than medical. Health depends much upon a balancing of forces, and disease upon a loss of this balance. Poisons are a part of all life, but these poisons have their natural relations to protective and eliminative organs, or a resistance on the part of the cells. When protection or elimination fails or cells become sensitive, disease is liable to result. Less frequently disease results from overwhelming poison.

[1] Wohlgemuth, *Berl. klin. Wchnschr.*, 1910, Nos. 48 and 49, Literature.
[2] Bywaters, *Journ. Physiol.*, London, 1910, vol. xli. p. 168.

XXI

LIFE INSURANCE

Arteriosclerosis and Life Insurance.—As arteriosclerosis closely resembles an involuntary process whose natural tendency is to imitate the process of growing old, and since age is the most important element in determining expectation of life, it is of the utmost importance in insurance.

Up to the present time, expectation has been largely estimated indirectly, by determining the average length of life of a man's ancestors, exclusive of those perishing from accidental causes. As an inherited tendency, the process, hardening of the arteries, may be determined by studying heredity, but the average age of ancestors should be supplemented by a search for special causes in the individual.

The real age of the man as determined by condition, and not by years, makes apparent age of great importance.

As a practical matter, persistent indicanuria (the index of intestinal putrefaction) should lead to a fear of premature arteriosclerosis, as should the habit of over-ingestion of food, the neglect of exercise and the strain of over-devotion to business without vacation. High blood pressure has already been adopted as a danger signal in life insurance, but low blood pressure should also be so considered. An increase of red blood cells above normal should take place beside overweight as a danger signal. Dilatation of the aorta might be examined for by the X-ray, and in general, the experienced examiner's belief whether the individual is of

the type to develop early arteriosclerosis. The history of a severe attack of typhoid or of any other prolonged infection should lead to a doubly careful examination of the arterial system.

The expectation of life in a person free from a suspicion of arteriosclerosis is certainly greater than one in whom its early development is to be looked for.

Migraine in early life is an indication of sensitiveness to influences that later lead to arteriosclerosis in some persons. The same cause that produces arteriosclerosis also causes kidney disease, so that the careful study of the urine has already, in a great measure, taken care of the interests of life insurance in regard to arteriosclerosis. Blood pressure measurement is a real contribution and acts as a check on the uranalysis.

Dr. Brandreth Symonds, Chief Medical Director of the Mutual Life Insurance Company of New York, has contributed valuable information from his extensive experience. He writes:—

"THE MUTUAL LIFE INSURANCE COMPANY OF NEW YORK.

NASSAU, CEDAR, LIBERTY AND WILLIAM STREETS.

MEDICAL DEPARTMENT.

BRANDRETH SYMONDS, M.D.,
Chief Medical Director.

WM. EVELYN PORTER, M.D.,
HENRY H. SCHROEDER, M.D.,
FRANCIS D. MERCHANT, M.D.,
FANEUIL S. WEISSE, M.D.,
Medical Directors

DR. LOUIS F. BISHOP,
54 WEST 55TH STREET,
NEW YORK CITY.

January 24, 1913.

"DEAR DR. BISHOP,—Your favour of the 20th inst. is at hand.

"In reply, I enclose a table of our experience in angina pectoris and arterial diseases for the past five years. The table speaks for itself. It seems to me of great interest to note the increase in deaths from these two causes during the

past five years. Part of the increase in arterial diseases is doubtless due to the fashion of correctly recording the cause of death as arteriosclerosis instead of some indefinite illness, but I think that part of it and all of the increase in angina pectoris is due to the increasing importance of these arterial diseases, for I regard angina pectoris as due in most cases to sclerosis of the coronary arteries.

"As to the etiology of arterial sclerosis, I cannot add anything of importance. One small circumstance indicates that a tendency to cerebral arterial diseases may be hereditary. In studying the influence of apoplexy or paralysis in the family record, I found that the presence of two or more cases in the family history materially increased the mortality. In these cases heredity, infection, or environment seems to have a decided effect in determining the mode of exit, for 21 per cent. of the deaths were due to apoplexy or paralysis, as compared with 8 per cent. among all men.

"I am convinced that over-eating is a more important factor in the causation of arterial diseases, probably more so than the over-use of alcohol. The exact method by which over-eating operates as a cause of arterial diseases cannot be stated at present, and it may operate in a number of different ways.

"We place a great deal of reliance on the measurement of the blood pressure when taken by experienced men.

"Let me know if I can be of any further service to you.—Sincerely yours,

"BRANDRETH SYMONDS, M.D.,
Chief Medical Director."

[TABLE

TOTAL DEATHS FROM ALL CAUSES AND FROM ANGINA PECTORIS AND ARTERIAL DISEASES RESPECTIVELY, DIVIDED INTO THREE SPECIFIC AGE GROUPS BY AGES AT DEATH, WITH THE PERCENTAGE TO THE TOTAL FOR EACH OF THE PAST FIVE YEARS.

Year.	Age Period.	Total Deaths.	Angina Pectoris.		Arterial Diseases.	
			Deaths.	Per cent.	Deaths.	Per cent.
1908	Under 45	1655	10	0·6	7	0·4
	45 to 59	1943	41	2·1	27	1·4
	60 and over	2266	50	2·2	120	5·3
	Total .	5864	101	1·7	154	2·6
1909	Under 45	1496	7	0·5	7	0·5
	45 to 59	2016	30	1·5	41	2·0
	60 and over	2431	58	2·4	129	5·3
	Total .	5943	95	1·6	177	3·0
1910	Under 45	1502	10	0·7	13	0·9
	45 to 59	2086	57	2·7	52	2·5
	60 and over	2575	74	2·9	144	5·6
	Total .	6163	141	2·3	209	3·4
1911	Under 45	1411	3	0·2	8	0·6
	45 to 59	2185	44	2·0	43	2·0
	60 and over	2634	64	2·4	162	6·2
	Total .	6230	111	1·8	213	3·4
1912	Under 45	1408	5	0·4	7	0·5
	45 to 59	2178	47	2·2	54	2·5
	60 and over	2755	78	2·8	179	6·5
	Total .	6341	130	2·1	240	3·8

Concerning blood pressure, Dr. O. H. Rogers, Chief Medical Director of the New York Life Insurance Company, writes as follows:—

"NEW YORK LIFE INSURANCE COMPANY,
346 AND 348 BROADWAY, NEW YORK.
DARWIN P. KINGSLEY, *President.*

MEDICAL DEPARTMENT.

O. H. ROGERS, M.D.,
Chief Medical Director.

E. H. LINES, M.D.,
T. W. BICKERTON, M.D.,
Medical Directors.

DR. LOUIS F. BISHOP,
54 WEST 55TH STREET,
NEW YORK CITY.

January 24, 1913.

"DEAR DR. BISHOP,—Answering your valued favour of the 20th inst., Dr. John W. Fisher, Medical Director of the North-Western Life Insurance Company, of Milwaukee, Wisconsin, read a paper at the 1911 Meeting of the Association of Life Insurance Medical Directors, which covers quite extensive observations on blood pressure as applied to Life Insurance. He read a second paper before the Association last year. These two papers contain all of the fully digested data on blood pressure with relation to life insurance with which I am familiar. Dr. Harry P. Woley, of Chicago, wrote a paper on 'The Normal Variation of the Systolic Blood Pressure,' in which he limits the normal pressure at various ages. This was published in *The Journal of the American Medical Association*, July 9th, 1910. I believe that you will be able to get all of these papers in the Academy Library; but if not, and if you will let me know, I shall be very glad to loan you my copies of them.

"While we, in this office, have gone quite extensively into the subject of blood pressure, and have a considerable amount of data, more or less accessible, I do not expect to make a systematic analysis until the latter part of the present year. My own observations agree entirely with Dr. Fisher's and Dr. Woley's; and from what I have seen

I am satisfied that my studies when completed will not differ, to any substantial degree, from the conclusions arrived at by Dr. Fisher, and the observations by Dr. Woley above referred to.—Very truly yours,

"OSCAR H. ROGERS,
Chief Medical Director."

The paper of Dr. J. W. Fisher,[1] in 1911, contains the following interesting matter:—

"The North-Western Mutual Life Insurance Company, in August 1907, required the best local examiners of the company in several of the larger cities to furnish the company with a blood-pressure reading of applicants examined

TABLE 1.—*The Average Systolic Blood Pressure, Accepted Risks at Ages* 15 *to* 39.

Ages.	Number.	Mm. Hg of Pressure.	Average Blood Pressure.
15 to 19 . .	21	2,479	118·00
20 to 24 . .	56	6,917½	123·53
25 to 29 . .	80	10,059	125·61
30 to 34 . .	86	10,793	125·50
35 to 39 . .	177	22,346½	126·25
Total . .	420	52,584	125·20

by them where the applicant's insurable age was forty to sixty years. (The company does not insure persons whose insurable age is over sixty.) Gradually this requirement has been extended to all localities where it has been possible to secure the blood-pressure reading, so that at the present time the blood pressure is furnished in all localities in which the company does business, where it is possible to induce the examiner to secure a sphygmomanometer. The blood pressure

[1] "The Diagnostic Value of the Use of the Sphygmomanometer in Examinations for Life Insurance," published in *Medical Record*, October 21, 1911, and read before the Association of Life Insurance Medical Directors, October 4, 1911.

is required, regardless of the amount applied for, in persons where the insurable age is between the years forty and sixty,

TABLE 2.—*The Average Systolic Blood Pressure, Risks accepted at Ages* 40 *to* 60.

Ages.	Number.	Mm. Hg of Pressure.	Average Blood Pressure.
40	1,112	142,050½	127·74
41	1,199	153,228½	127·80
42	1,163	149,015½	128·13
43	994	127,755½	128·53
44	956	123,651½	129·34
Total	5,424	695,701½	128·26
45	895	115,962½	129·57
46	857	111,856½	130·52
47	748	97,687½	130·60
48	727	95,607½	131·51
49	640	83,553½	130·55
Total	3,867	504,667½	130·51
50	626	88,296½	131·46
51	515	67,539	131·14
52	371	49,137	132·44
53	369	48,988½	132·76
54	288	38,327	133·08
Total	2,169	286,288	131·98
55	292	39,106	133·92
56	223	29,952	134·31
57	197	26,531	134·67
58	159	21,238½	133·57
59	127	17,223½	135·62
60	189	25,549	135·18
Total	1,187	159,600	134·46
Grand Total	12,647	1,646,257	130·17

and at any age where the medical department deems it advisable. In our home office examinations of the blood pressure are taken at all ages. We therefore have a record of 420 accepted cases under ages 40, with a blood pressure average of 125·20 mm. Hg. (See Table 1.) In addition, 26 applicants under age 40 were rejected, whose blood-pressure was 150 mm. Hg or over.

"By reference to Table No. 2, it will be seen that 12,647 persons were insured with an average blood pressure, at ages 40–60, of 130·17 mm. Hg; at ages 40–44, this average was 128·26 mm. Hg; at ages 45–49, average 130·51 mm. Hg; at ages 50–54, average 131·98 mm. Hg; at ages 55–60, average 134·46 mm. Hg. In all of the readings the pressure was adjusted as nearly as possible to a cuff of 12 cms. in width.

TABLE 3.—*The Average Systolic Blood Pressure, Risks accepted whose Weight exceed the Average by more than* 20 *per cent.*

Ages.	Number.	Mm. Hg of Pressure.	Average Blood Pressure.
Under 40 . .	21	2,675	127·38
40 . . .	76	9,942½	130·82
41 . . .	72	9,484½	131·73
42 . . .	102	13,440½	131·77
43 . . .	87	11,418½	131·25
44 . . .	70	9,325	133·21
Total .	407	53,611	131·72
45 . . .	90	11,994	133·27
46 . . .	67	8,882	132·57
47 . . .	86	11,644½	135·40
48 . . .	83	11,253	135·58
49 . . .	52	7,106	136·66
Total .	378	50,879½	134·60
Grand Total .	806	107,165½	132·96

"By reference to Table No. 3, you will find that 806 persons were insured whose weight exceeded the average by more than 20 per cent.; 21 of these were under age 40, with an average pressure of 127·38 mm. Hg; 407 were insured at ages 40–44, with an average pressure of 131·72 mm. Hg, and 378 were insured at ages 45–49, with an average blood pressure of 134·60 mm. Hg. In all cases where a number of blood-pressure readings were taken the average blood pressure was used in compiling the tables, showing the average at the different ages.

TABLE 4.—*Mortality of Accepted Risks with Systolic Blood Pressure of* 140–149 *mm. Hg, with an Average of* 142·43 *mm. Hg, All Ages.*

Years.	Number.	Expected.	Actual.	Per cent.
1907 . .	217	11·338	4	35·279
1908 . .	652	30·178	12	39·764
1909 . .	953	27·800	8	28·777
1910 . .	846	12·541	7	55·817
Total . .	22,668	81·857	31	37·870

"Table No. 4 shows the mortality (taken by the Actuary's Table) of 2668 insured, with a blood pressure of 140–149 mm. Hg, was 81·85 expected deaths, 31 actual deaths, a percentage of 37·87, which is slightly below the normal death-rate of the company on exposure of two years. It should be stated that the average exposure in all of these cases was 2·09 years, covering a period from August 1907 to January 1, 1911, and carried up to the anniversary of the policies to July 1, 1911.

"Table No. 5 shows the mortality record of 525 persons insured with a blood-pressure reading of 150 mm. Hg and over, with 22·19 expected and an actual of 12 deaths, which is about 35 per cent. in excess of the general average mortality of the company covering the same period, and 18 per cent. higher than the general average mortality during

the first five years of exposure covering the 20-year period 1885–1905.

TABLE 5.—*Mortality of Accepted Risks with Blood Pressure of 150 mm. Hg, and over; Average 152–59 mm. Hg, All Ages.*

Years.	Number.	Expected.	Actual.	Per cent.
1907 . .	87	4·884	5	102·370
1908 . .	210	10·654	6	56·317
1909 . .	163	5·547	0	0·0
1910 . .	65	1·112	1	89·929
Total . .	525	22·197	12	54·062

"Table No. 6 shows a mortality record of 722 persons declined for insurance, in whom the blood pressure averaged 171·03 mm. Hg; 20·61 deaths expected, with 32 actual deaths, a percentage of 155·27, almost four times greater than the general average of the company.

TABLE 6.—*Mortality of Applicants rejected with Average Blood Pressure of 171·03 mm. Hg, All Ages.*

Years.	Number.	Expected.	Actual.	Per cent.
1907 . .	40	2·495	9	360·72
1908 . .	119	6·187	9	145·47
1909 . .	209	7·253	9	124·09
1910 . .	225	4·119	4	97·11
1911 . .	129	0·555	1	180·18
Total . .	722	20·609	32	155·27

"Table No. 7 shows 356 of the 722 rejected cases in which there were one or more other impairments than the high blood pressure. The nature of the impairments will be found in Table No. 8. Of the 356 cases, 10·47 deaths were expected, with an actual of 18 deaths, or a percentage of 171·93 of the table.

TABLE 7.—*Mortality of Applicants rejected with High Blood Pressure (Average, 171·73 mm. Hg) and one or more other Impairments.*

Number.	Expected.	Actual.	Per cent.
356	10·469	18	171·93

TABLE 8.—*Impairments recorded on Applications at Time of Medical Examination of the 356 Cases recorded in Table No. 7 above.*

Arteriosclerosis. — Atheroma.	Heart Murmur.	Heart Hypertrophy.	Albumin and Sugar.	Albumin in Urine.	Sugar in Urine.	Albumin and Casts.	Casts in Urine.	Nervous Symptoms.	Prostatic Disease.	Miscellaneous.	Total.
53	69	17	10	110	14	10	6	21	5	41	356

"Table No. 9 shows 366 cases, the remainder of the 722 rejected, in which there were no other impairments than the high blood pressure recorded on the application at the time of its receipt at the home office. The expected deaths were 10·14, with an actual of 14 deaths, or 138·07 per cent. of the table.

TABLE 9.—*Mortality of Applicants rejected with High Blood Pressure only.* (*Average, 170·36 mm. Hg.*)

Number.	Expected.	Actual.	Per cent.
366	10·140	14	138·07

"Table No. 10 shows subsequent impairments reported in the 366 cases recorded in Table No. 9. You all appreciate the difficulty of securing additional data on rejected cases.

In all of the rejected cases, especially the 366 noted in Table No. 10, a special effort was made to have repeated readings of the blood pressure and examinations, with a view to discover, if possible, the probable cause of the high blood pressure or what might in any way account for it. We invariably called for a specimen of the urine to be forwarded to the home office for chemical and microscopical examination, with the results shown in Table No. 10. In almost all of the impairments in which casts, albumin and sugar were found, and in some of the heart lesions, these impairments were discovered on examinations made at the home office, or were secured at a later date by furnishing the local examiner

TABLE 10.—*Impairments Subsequently Discovered or Developed in the* 366 *Cases recorded in Table No.* 9 *above.*

Arteriosclerosis. — Atheroma.	Heart Murmur.	Heart Hypertrophy.	Albumin and Sugar.	Albumin in Urine.	Sugar in Urine.	Albumin and Casts.	Casts in Urine.	Nervous Symptoms.	Miscellaneous.	Total.	Expected.	Actual.	Per cent.
6	9	4	2	13	5	33	13	6	10	101	3·061	4	130·66

who made the original examination with a list of the cases and the name of the applicant's family physician, through whom the local examiner might determine as to the physical condition of the applicant. In some instances the local examiner saw and examined the applicant at a considerable period subsequent to our declination. By this method we have secured recent reports on about 90 per cent. of the inquiries made on declined cases where the applicant held no insurance in this or other companies in the interchange. We have made an effort in various other ways to bring the records up to date on all of these rejected cases. In the same manner, we have endeavoured to secure the cause and date of death of those who died.

"It will therefore be seen that the mortality shown in the tables covering the rejected cases is undoubtedly more favourable than the exact facts would show, as the chances are, with all the care we have taken to follow up rejected cases, that some deaths must have occurred of which we have no record.

"Table No. 11 shows the causes of death of, first, the 525 risks accepted (see Table No. 5), with a blood pressure of 150 mm. Hg or over (with an average blood pressure of 152·58 mm. Hg), the average blood pressure of those who

TABLE 11.

Causes of Death.				Causes of Death.
Risks accepted as shown in Table No. 5. Average blood pressure of those who died was 151·71 mm. Hg.		Angina pectoris	2	Risks rejected as shown in Table No. 6. Average blood pressure of those who died was 183·61 mm. Hg.
	1	Aneurysm aorta	1	
	1	Apoplexy	7	
	1	Arteriosclerosis	1	
		Appendicitis	2	
	1	Cirrhosis of liver	2	
	1	Cancer of liver		
		Duodenal ulcer	7	
	2	Heart disease—Organic	8	
	1	Nephritis		
	1	Pneumonia		
	1	Prostatic hypertrophy		
	1	Railway accident		
	2	Rheumatism—Acute		
		Suicide	1	
		Stokes-Adams disease	1	

died being 151·71 mm. Hg; and second, the 722 cases rejected with a blood pressure of 171·03 mm. Hg, the average pressure of those who died being 183·61 mm. Hg. (See Table No. 6.)

"Three hundred risks were accepted with blood pressure of 109 mm. Hg and under, an average of 103·43 mm. Hg, with only three deaths. Of these, 248 were insured at ages 40–50, with two deaths; 52 at ages 50–60, with one death; 1488 risks were insured with an increased blood pressure at ages 40–50, with one death; 302 at ages 50–60, with four deaths.

"The local examiners are furnishing the company with

blood-pressure readings in their examinations in about 500 cities, towns and localities in which the company does business.

"The records of this company show that during the period from August 1907 to January 1911, the blood pressure of 13,789 applicants was furnished the company, and that in 1247 of these cases the blood pressure was 150 mm. Hg or over, with a mortality of 102·80 per cent. of the table; 33 of these were under age 40 and the remainder were ages 40 to 60. The percentage of high tension was about 8 per cent. in the younger group and 9 per cent. in the older group.

"Notwithstanding the number of cases under observation at ages under 40 is comparatively small, in my judgment the results are sufficient to justify insurance companies requiring the use of the sphymomanometer in examinations for life insurance of applicants under age 40, at least until a large number of cases have been under observation for a sufficient length of time to enable us to definitely determine the diagnostic value of the sphygmomanometer at the younger ages."

Practically all life insurance companies require blood-pressure measurements for large risks, and very soon will probably require it in each examination.

Dr. H. P. Woley's paper,[1] referred to by Dr. Rogers, gives the following observations on normal pressure:—

"With these ideas in view I have collected during the past three years the readings of 1000 blood pressures, all of supposedly healthy individuals. There has been excluded every case of kidney disease and heart disease—in fact, every case in which there was a pathologic condition found, either from physical examination or from the history. These cases represent typical, healthy individuals ranging in age from 16 to 65. These records were all taken by five different physicians. Often they were taken by two physicians working together. Again, records were made at the same sitting with two different instruments—for instance,

[1] "The Normal Variation of the Systolic Blood Pressure—A Study of One Thousand Cases."

the mercury column and the Dr. Rogers' 'Tycos' sphygmomanometer. From time to time instruments were corrected or standardized by subjecting them to the same pressure and then the reading taken.

"This was done by using the usual 5-inch cuff, but one having several openings or rubber tubes, to each of which a sphygmomanometer was attached. When the pressure was raised in the rubber bag an equal pressure was made at the same time on other instruments. This was done to reduce the liability to error and to secure, as far as possible, an accurate and uniform reading.

"All the results herein recorded were made by using a 5-inch cuff about the arm of the subject in a sitting posture, and the systolic reading taken at the point at which the impulse disappeared and reappeared with the finger on the radial artery.

"In a comparison and study of many cases in the last five years I believe that at any age a constant blood pressure of 160 mm. or over is pathologic, and therefore should be excluded from forming any part of the results or conclusion reached in this paper. Many of these cases have been studied where it was possible, and albumin and casts have been found in the urine sooner or later, although sometimes in small amounts. It explains the condition, however. This has been of considerable value, as many risks might have been accepted as first class were it not for the abnormal elevation in blood pressure which led to further study.

"Experience has taught us that the selection of a single individual's blood pressure, as a high mark or a low mark, will be manifestly unreliable, while it is equally certain that the general average of a group of blood pressures will give pretty nearly the truth. The larger the group the more accurate the results.

"It is found to be practically correct in considering vast numbers of supposedly healthy individuals that about 85 per cent. prove to be healthy and 15 per cent. are questionable.

"Following this principle, I shall take the general average of the group of 15 per cent. for the highest blood pressure, and the general average of the group of 15 per cent. for low blood pressure, and designate them as average high and average low blood pressure. With this explanation the results reached after a study of 1000 blood pressures are as follows:—

"The average blood pressure of all ages was 127·5 mm. The average blood pressure for females at all ages was 120 mm. By taking them in groups from 15 to 30 the average blood pressure was 122 mm., the average high blood pressure being 141 mm. and the average low 103 mm.

"Second: those from 30 to 40 years of age should give an average blood pressure of 127 mm., an average high of 143 mm. and an average low of 107 mm.

"Third: those from 40 to 50 years of age gave an average blood pressure of 130 mm., an average high of 146 mm. and an average low of 113 mm.

"Fourth: those from 50 to 60 years of age gave an average blood pressure of 132 mm., an average high of 149 mm. and an average low of 115 mm.

"There is a gradual rise in blood pressure as the years advance. There is also a corresponding rise in the high and low averages. It can readily be seen that between 50 and 60 years of age a man giving a blood pressure of 145 mm. would undoubtedly be accepted without further question, while a man under 30 years of age showing the same pressure would present a case for further study and investigation.

"I have selected a group from 55 to 65 which gives an average blood pressure of 138 mm., an average high of 153 and in average low of 120.

"There are a few points worthy of notice that might be mentioned here, namely, in regard to the pulse, rapid or slow. The average blood pressure in all cases with a pulse under 65 was 123 mm., while the average blood pressure in all cases with a pulse over 85 was 130 mm.

"It was also noticed that there were quite as many healthy individuals with a pulse over 85 as there were with a pulse under 65."

It would perhaps be possible for life insurance companies to grant a diminished rate to persons who would agree to submit to re-examination once in six months, because it is universally acknowledged by all workers in arteriosclerosis that every few months of a proper regimen at the beginning of the disease means years of life at the end. How often I have said to people with very high blood pressures and all the dangers that go with it, "I wish I had seen you ten years ago." The answer always is, that they felt perfectly well at that time.

When the arteries that can be easily reached and examined are thickened, even though high blood pressure does not exist, these people are bad subjects for insurance. Often enough, a most careful study will not reveal the underlying cause. It is seen in comparatively young persons —the probability of chronic auto-intoxication with hypotensive elements. However, syphilis must not be forgotten.

The great value of blood pressure measurements in life insurance is, that it leads to a careful scrutiny of the condition of the kidneys, which in high pressure are nearly always found to be involved. The accumulation of experience has been so great in the last five years that there is no longer any question of the value of this additional observation in life insurance, and five years from now it will probably be regarded as a matter of course. The proportion of persons showing hypertension associated with arteriosclerosis will be much less in the life insurance examinations than in the experience of the general practitioner. A person does not go for a life insurance examination when he is suffering from many of the causes of temporary hypertension.

For the same reason, the specialist in cardiovascular disease does not see many examples of functional hypertension that are reported as relieved by special forms of treatment but only persons in whom there is a very definite

suspicion of tangible disease on account of an irreducible minimum of pressure. In arterial disease there is established this irreducible minimum of pressure, and it is this that determines the status of the individual.

Undue rapidity of the pulse is always an important sign of real trouble when it accompanies high blood pressure.

In order that measurement should be of the greatest value, uniform methods and instruments should be adopted. The cuff should be 5½ inches wide. The sitting posture is by far the most satisfactory in the long-run, and should be adopted as standard

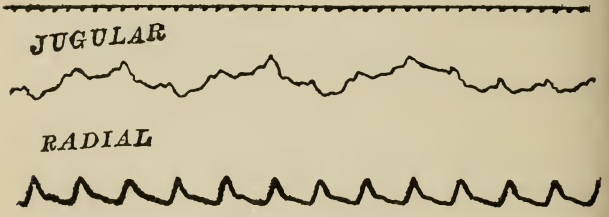

Fig. 25.—Tracing from Mr. D.

Many people are discovered to be suffering from arteriosclerosis only when they are examined by life insurance companies, showing the frequency of this condition without conscious symptoms.

Mr. D. had decided to take an annuity on his life, when the gentleman who was selling the annuity at the same time thought that it would be well for him to carry life insurance. The two transactions were to be carried out at the same time; but the life insurance was refused. It occurs to the writer that if he had taken both in the same company, one would have offset the other. However, that is not a medical matter.

He presented himself for examination because he wished to know his chances of finding the annuity a profitable investment. He said he felt perfectly well. His father had

died of typhoid fever at the age of thirty-four; mother living at the age of seventy-eight. His paternal grandfather lived to the age of eighty; his paternal grandmother to eighty-five; his maternal grandfather lived to the age of fifty-eight; and his maternal grandmother to the age of eighty-eight. He had one sister who was living and well, a wife who was living and well and one child.

He was a tall, blonde, strongly-knit man, weighing 173 pounds. He gave a history of sleeping poorly, but otherwise he enjoyed perfect health. He had never had any severe illness, except a severe attack of dysentery when he was seventeen years of age. He had lived well; and drank moderately.

His heart was somewhat hypertrophied, and there was a soft, blowing systolic murmur over the sternum. His blood pressure was 180 mm. Hg, and his radial artery showed a moderate degree of thickening. His urine was of normal specific gravity, and showed an excess of indican, and a few hyaline granular casts; there was no albumin. His haemoglobin was over 100 per cent.

No immediate cause for his arteriosclerosis could be discovered, and the attack of dysentery seemed to be too early to be the origin of his trouble, though it was perfectly possible that at that time he developed sensitiveness to some protein.

The gentleman was advised that he was suffering from arteriosclerosis and that the profitableness of his annuity would depend upon his adherence to a regimen.

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